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NEW SERIES, VOLUME LXV

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A PRACTICAL JOURNAL BUILT ON MERIT

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NEW SERIES VOL. LXV JULY, 1944 NUMBER ONE

Editorial

THE SIGNIFICANCE OF TRANSILLUMINATION OF THE CERVIX UTERI

THE cervix, before it is damaged by infection, parturition or operation, is neatly arranged with columnar epithelium lining the canal in a definite pattern and terminating abruptly at the small external os.

Parturition leaves the external opening relaxed and the endocervical mucosa hyperactive. The increase in alkaline mucus makes conditions unfavorable for the squamous epithelium covering the portio, and for a variable distance around the external os it is replaced by columnar epithelium in the form of the familiar so-called erosion.

As the uterus recovers from the effects of pregnancy and parturition, the activity of the columnar epithelium subsides and the quantity of mucus decreases. This allows the squamous epithelium to replace the columnar over the portio. If the portio has not been invaded by deep-growing glands, the erosion may disappear, leaving the cervix in approximately normal condition.

In a large proportion of cases this happy result does not occur. The gland-bearing columnar epithelium penetrates the portio and some of the glands become cystic. These may be superficial cysts, the size of a millet seed, or they may be larger and deeper. The cervix may be mottled by intermingled islands of the two types of epithelium, or the entire surface may be recovered by squamous epithelium. Under this second growth may be found cysts which have not been rooted out by the regrowing squamous epithelium.

The cervix, therefore, becomes a battleground of epithelial types and may remain so during the period through which children are born.

Erosions, superficial cysts and leucoplakia are easily seen with proper lighting, but the underlying tissue of the portio remains out of sight unless the examiner resorts to transillumination.

Transillumination reveals the more deeply-buried cysts, which shine out as clear areas if mucus-filled. Often there is a sediment of pus in the cyst which makes a dark center to the light cyst. This sediment is often visible, with ordinary illumination, as a white spot showing through the mucosa. Therefore, when a white spot of pus is seen, one can predict with confidence that it is in a cyst.

The healthy cervix is uniform in appearance under the transilluminating light. If dark streaks made by blood vessels are seen, it indicates the presence of inflammatory hyperemia.

The writer has used transillumination continuously since discovering this method of examining the cervix in 1926. He has become more and more impressed with the large amount of cervical disorders which are missed by the usual methods of examination. He has also been impressed by the inadequacy of treatment which has not been controlled by transillumination.

Experience with transillumination points the way to the rational treatment of the cervix. Cysts indicate the areas where there is buried disease, and their absence indicates the areas where treatment may be superficial.

Treatment is given shortly after a menstrual period. The writer waits until about three months after parturition, as much of the pathological condition disappears spontaneously with involution.

The writer electrocoagulates deeply where there are cysts hidden under the portio epithelium, and superficially all of the erosion area, extending the coagulation a short way into the relaxed external os. This treats the area which is most apt to produce cancer and extensively reduces the mucus-producing area. It also leaves the upper part of the canal to secrete a certain amount of mucus, which is desirable.

In the writer's opinion, if the practice of transillumination became universal, an immense amount of cervical disorders that are overlooked today, would be discovered and treated. When that day comes, if the treatment of the cervix prevents cancer, the incidence of cancer of the cervix should decline tremendously.

When man finds a dangerous spot in a road, he hangs out a red lantern. Nature has hung a red lantern in the cervix and it is the duty of the profession to look for it.

LEONARD R. THOMPSON, M.D.

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Original Articles

ADENOMA OF THE KIDNEY*

REPORT OF SIX CASES

CHARLES C. HIGGINS, M.D.
CLEVELAND, OHIO

RENAL adenomas were first accurately described by Sturm[1] in 1875. Although multiple small adenomas are not uncommon in kidneys which are the seat of vascular disease, a simple adenoma of the kidney of palpable size is seldom observed. Occasionally, pain and hematuria may occur. Because of the clinical rarity of this neoplasm a report of the following cases seems justified.

CASE REPORTS

CASE I. A woman, aged forty-seven, was seen in the Clinic November 21, 1935, complaining of "blood in the urine for varying periods in the past year." At first she had believed the pink-staining urine to be spotting from the vagina. During the past month blood had frequently been noticed in the urine. Four months after the onset of hematuria a severe colicky pain to the right of the umbilicus had radiated to the right flank. Chills with slight fever had been present, but no nausea nor vomiting. The patient had lost and regained twenty pounds. For several weeks she had lacked energy and had had frequent attacks of pain and soreness in the right quadrant. Frequency and urgency of elimination and dysuria had been present for several years.

She had dyspnea on exertion with dependent edema of the ankles, but reported no history of precordial pain. Menopause had occurred eight years before; vaginal bleeding had lasted for one day nine months previous to the present illness.

Physical examination revealed a well developed, obese, nervous woman. The blood pressure was 160 systolic and 98 diastolic. The abdomen revealed panniculus adiposus without mass formation; there was moderate tenderness in the right upper quadrant.

Cystoscopy revealed that the bladder contained a small amount of urine, and 150 cc. of solution was introduced without distress to the patient. The bladder was negative for calculi, ulcer, tumor, or diverticulum. Both ureteral orifices were seen and catheterized without encountering obstruction. Specimens were readily obtained from both sides.

An initial roentgenogram with the catheters *in situ* was normal. Bilateral pyelograms taken after the injection of 10 cc. skiodan into each kidney were unsatisfactory because the patient changed position. An intravenous urogram showed prompt function from both kidneys. A filling defect in the middle of the pelvis of the right kidney was believed to be due to a neoplasm, probably a hypernephroma. The left kidney was normal. Another retrograde pyelogram made the following day confirmed the report of the previous day with the additional impression of a possible papilloma of the kidney pelvis.

Laboratory studies revealed the following: Red blood cell count, 4,650,000 per cu. mm.; hemoglobin, 91 per cent; white blood cell count, 5,400 per cu. mm.; neutrophils, 73 per cent; lymphocytes, 27 per cent; blood urea, 30 mg. per 100 cc.; blood sugar, 113 mg. 6 hr. postprandial; urinalysis: specific gravity, 1.070; acid reaction; albumin, 0; sugar, 0; blood Wassermann and Kahn, negative.

On December 3, 1935, a right ureteronephrectomy was performed under spinal anesthesia.

The pathologic report was as follows: The specimen weighs 183 Gm. and measures 12 by 5 by 5 cm. The consistency of the specimen is greatly reduced. On the posterior surface just below the hilus a soft rounded elevation measures 1.5 cm. The capsule strips with ease, leaving a smooth surface. On cut section the cortex measures 0.9 cm. The markings are distinct. The pelvis of the kidney is dilated and measures 7 cm. in length and 4 cm. in the greatest circumference. Partially overlying the ureteral opening a circumscribed soft tumor mass projects into the kidney pelvis, apparently from a papilla, and is continuous with the tumorous bulging described on the external surface. The tumor within the pelvis of the kidney measures 4.2 by 3.0 by 2.0 cm. It has a comparatively smooth surface but is covered with a thin encrustation of urinary sediment. A bilobed smaller tumor mass extending at right angles from the base of this tumor measures 2.0 by 1.5 cm. and is apparently continuous with the tumor mass described on the external surface. Except for the central necrotic area it is grayish white and slightly granular in appearance. The ureter is patent and measures 19 cm. in length. There is no gross evidence of any tumor along the course of the ureter.

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* From the Cleveland Clinic, Cleveland.

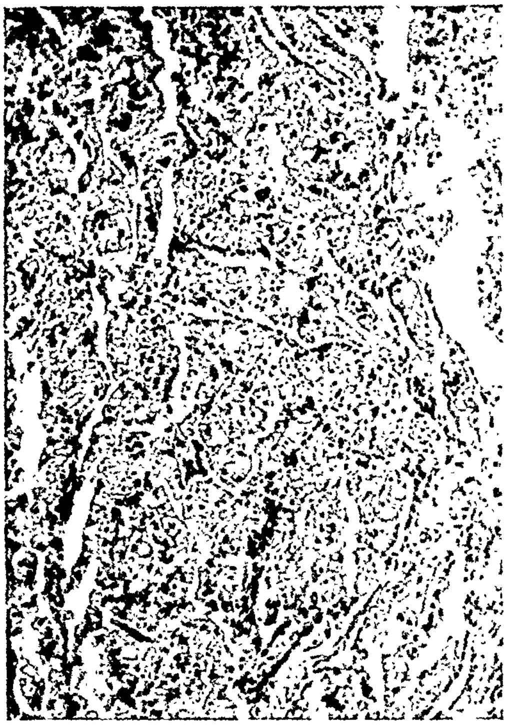

Fig. 1. Microscopic section of adenoma of right kidney probably originating in tubular epithelium.

Microscopically (Fig. 1) along one margin section shows practically normal kidney tissue except for thickened capsule and round cell infiltration. The remainder of the section consists of a densely encapsulated tumor, composed of irregular masses of large, well defined, pale, pink-staining, somewhat vacuolated, epithelial cells having relatively small nuclei. The masses of epithelial cells are separated by a very delicate vascularized stroma. There are no dense masses of connective tissue in the tumor. The tumor cells are fairly uniform in size and type and show some tendency to polarization around the blood vessels. In the capsule of the tumor are a few atrophic glomeruli but no recognizable renal tubules. Section through the polypoid mass projecting into the pelvis shows complete loss of pelvic epithelium and considerable, finely granular, calcium deposit on the surface. The tip of the projection shows considerable diffuse hemorrhage into the tumor tissue. This section and the first are essentially the same, and in certain parts the tumor cells tend to assume a tubular arrangement. Section through the lower end of the ureter shows no abnormality.

Diagnosis: Adenoma of the right kidney probably originating in tubular epithelium. The patient had an uneventful convalescence and left the hospital on the fifteenth day following nephrectomy. The last visit to the Clinic was on January 25, 1941, at which time the patient was free of symptoms.

Case II. A machinist, forty years of age, entered the Clinic October 12, 1939, complaining of pain in the back and right side. Three years previously he had experienced very severe pain in the right subcostal area and right upper quadrant, which had required an injection of morphine for relief. The attack had lasted for two days. A diagnosis had been made of renal calculi. During the past three years he had experienced three similar attacks. The last attack four months previously had begun with severe pain in the back on the right side and again required morphine for relief; the following morning the pain had been more pronounced in the right upper quadrant. Since that time the pain had been almost constant. He had not observed blood in the urine. During the past three days the pain had been very severe.

The physical examination revealed a well developed young man. Pulse rate was 70; blood pressure 170 systolic and 114 diastolic.

A large mass was palpable in the right upper quadrant extending 3 inches below the costal margin and to the left of the midline in the epigastrium. It was also palpable in the right flank and was firm, not tender, and not freely movable. A scar from an appendectomy in 1918 was present. The prostate was slightly enlarged on rectal examination.

Laboratory studies revealed the following: Red blood cell count, 4,930,000 per cu. mm.; hemoglobin, 91 per cent; white blood cell count, 5,900 per cu. mm.; neutrophils, 89 per cent; lymphocytes, 11 per cent; blood urea, 36 mg. per 100 cc.; blood sugar, 98 mg. per 100 cc.; urinalysis: specific gravity, 1.015; albumin, faint trace; rare white blood cell on microscopic examination; Wassermann, negative.

The initial roentgenogram showed a normal lumbosacral region. The left kidney was normal in size, shape, and position. A large mass was present in the right renal area. The intravenous urogram revealed no evidence of function of the right kidney. The left kidney appeared normal. The retrograde pyelogram showed a large hydronephrosis of the right kidney with elevation of the pelvis from a large mass occupying the lower pole of the kidney. The upper right ureter was displaced medially. The urine from this kidney revealed an occasional white blood cell; the culture was normal.

A final diagnosis was made of tumor of the right kidney, hydronephrosis, and hypertension. A right nephrectomy was performed on January 3, 1940. Convalescence was uninterrupted, and the patient was discharged from the hospital sixteen days later.

The pathologic report was as follows: The gross specimen consists of the right kidney; 1,500 cc. of bloody fluid and débris was evacuated from the cyst of the kidney. After formalin fixation and evacuation of its contents, the kidney weighs 532 Gm., measures 16.5 by 16.5 by 11.5 cm., and consists of one large cyst the shape of a flattened sphere. One solid area on the circumference appears to be kidney tissue, measures 6 by 9 cm. and is raised 3 cm. above the surrounding cyst wall. Emerging from under one margin of this area is a segment of ureter, which measures 12 cm. in length and courses over the surface of the cyst, being bound to it by adhesions.

On section the lumen of the cyst contains a small amount of granular débris and a laminated blood clot. The cyst wall measures 3 to 4 mm. in thickness; an area of compressed kidney tissue at the periphery was identified on the surface. In this compressed area are the flattened pelvis and calyx from which a probe may be passed into the ureter. The cavity of the cyst is independent of the kidney pelvis. Flattened, laminated areas of yellowish tissue in the cyst wall may be tumor.

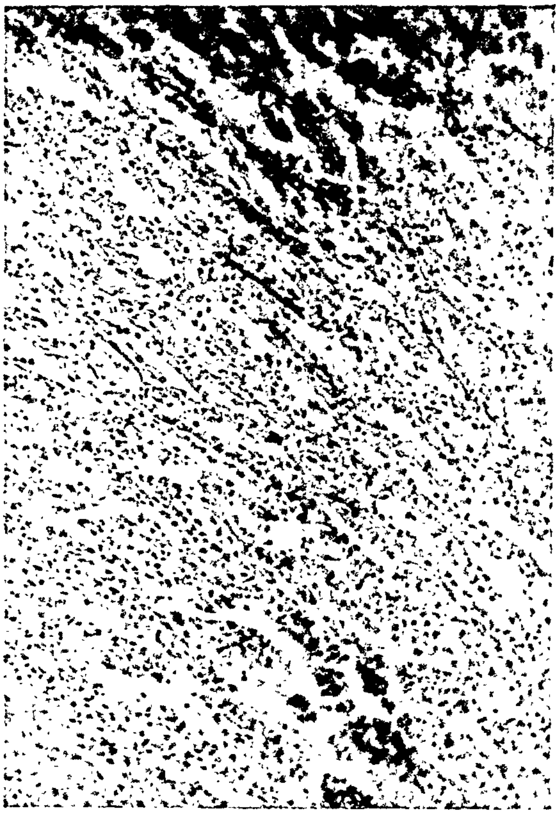

Fig. 2. Microscopic section of degenerating cystic adenoma of right kidney.

Microscopically, (Fig. 2) a section through the kidney shows rather marked atrophy, fibrosis, and a diffuse interstitial inflammatory reaction throughout the cortex and medulla. The pelvic mucosa is practically normal. The section including a portion of the cyst wall consists of atrophic fibrotic kidney tissue, and a layer of dense connective tissue. The inner surface of the cyst is lined with blood clot in which no tumor tissue is identified. A section through the thickened area of the cyst wall shows atrophic kidney tissue along one surface. Attached to the inner surface of the cyst wall is a nodule of adenomatous tumor tissue of renal origin, which is histologically benign, is well encapsulated, and does not appear to be invasive. On the inner surface of the tumor nodule are necrotic tumor tissue and blood clot. Section through the thin portion of the cyst wall shows a dense connective tissue capsule with a layer of blood clot on the inner surface but no identifiable kidney tissue. One small area of adenomatous tissue lies on the inner surface of the blood clot.

Diagnosis: Degenerating cystic adenoma of the right kidney.

CASE III. A housewife, aged forty-five, entered the Clinic, November 10, 1941, complaining of pain in the right flank radiating to the right groin. For the last ten to twelve years the patient had had "attacks of cystitis," characterized by dysuria, urgency, frequency, and pyuria usually accompanied by terminal hematuria. Relief had always been afforded by mandelic acid. The last attack had been in 1938.

Two days prior to this admission she began to feel ill generally. The only specific complaint was pain in the right flank. Her temperature fluctuated between 99°F. and 100°F. She experienced no chills nor systemic symptoms. On sulfonamide therapy her temperature returned to normal, but the malaise persisted. The day before admission the dull aching pain in the right subcostal area was more pronounced, and a hypodermic of morphine was administered for relief.

On the day of admission the pain was again quite severe, and gross blood was observed in the urine. Physical examination showed a well developed woman with a temperature of 99°F. Blood pressure was 120 systolic and 80 diastolic; pulse rate was 84. The right kidney was enlarged and tender.

Laboratory studies revealed the following: Red blood cell count, 3,900,000 per cu. mm.; hemoglobin, 71 per cent; white blood cell count, 12,700 per cu. mm.; neutrophils, 87 per cent; eosinophils, 2 per cent; lymphocytes, 11 per cent; blood urea, 45 mg. per 100 cc.; blood sugar, 102 mg. per 100 cc.; creatinine, 1.7 mg. per 100 cc.; urinalysis: specific gravity, 1.015; Ph, 6.5; albumin, 3 plus; red blood cells on microscopic examination, 3 plus; Wassermann, negative.

The initial roentgenogram showed a normal lumbosacral region and left kidney. The right kidney was not satisfactorily visualized. Bilateral pyelograms showed a normal left kidney. The right kidney was incompletely filled and showed a smooth, filling defect involving the pelvis. The lower calyx was not demonstrated, which indicated the presence of a tumor or blood clot. A right pyelogram one week later showed a filling defect of the pelvis of the kidney with apparent involvement of the inferior calyx.

A papillary tumor of the renal pelvis was suspected, and a right nephrectomy was performed December 4, 1941. The convalescence was uninterrupted, and the patient was discharged from the hospital two weeks later.

The pathologic report (Fig. 3) stated that the specimen consists of the right kidney weighing 408 Gm. The kidney is considerably distorted by a large, spherical, encapsulated mass bulging from the anterior surface and measuring 9 cm. in diameter. On section through the kidney, the upper calyx is normal. Projecting into the pelvis is a large, dark, hemorrhagic polypoid mass, at the crest of which the mucosa has sloughed, and the area is covered with a blood clot. On section through the tumor the surface consists largely of dark hemorrhagic infarcted necrotic tissue. Around the periphery of the tumor are areas of less altered tumor, which have a mottled red, brown, gray, and yellowish appearance. The tumor appears to be entirely encapsulated except at the site of ulceration in the pelvis, and there is no apparent invasion of adjacent tissue or blood vessels. Two sections show an encapsulated tumor apparently of adenomatous type, but complicated by extensive degenerative changes with hemorrhage and necrosis and proliferation of connective tissue. In small areas a considerable amount of lipoid material is present in rather large cells, but histologic arrangement and character of the cells does not suggest hypernephroma. The tumor appears to be well confined within its capsule and is not invading kidney tissue.

Diagnosis: Degenerating adenoma of the right kidney.

On November 20, 1942, approximately one year after operation the patient was free of symptoms.

CASE IV. A housewife, aged forty, entered the Clinic, February 18, 1933, complaining of weakness and a mass in the left side. Since the birth of a child eighteen months before, the patient had noticed dizziness and weakness. A few days after delivery, she had experienced pain in the left upper quadrant, which had entirely subsided. Before delivery the blood pressure had been stated to be 200 systolic and 105 diastolic but recently had been normal. Constipation had been present for one month, and she had been aware of a mass in the left upper quadrant.

Physical examination revealed an obese woman, apparently in good physical condition. Temperature was 99.4°F. There was a 1 plus enlargement of the thyroid with a small adenoma in the left lobe. Blood pressure was 114 systolic and 75 diastolic. Pulse rate was 90. A large tumor was palpable in the left upper quadrant and was irregular, firm, and not freely movable. The mass extended into the left flank and was not tender.

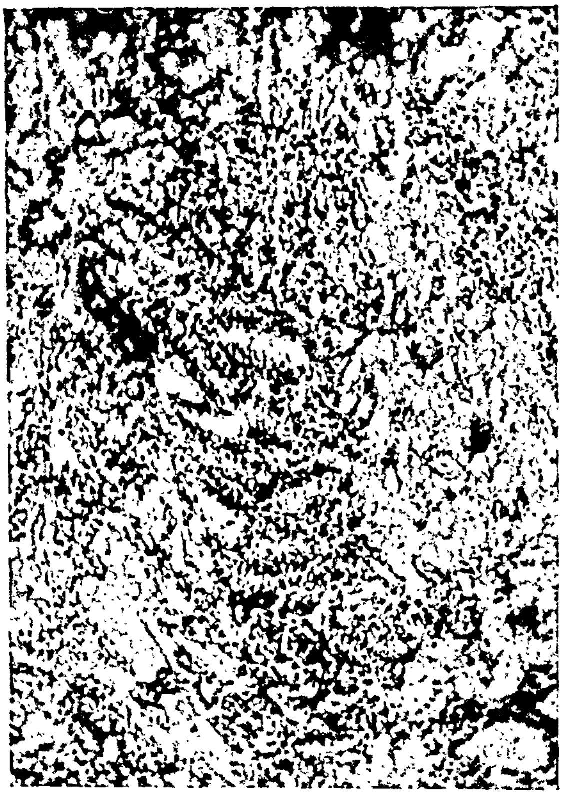

Fig. 3. Microscopic section of degenerating adenoma of right kidney.

Laboratory studies revealed the following: Red blood cell count, 4,400,000 per cu. mm.; hemoglobin, 84 per cent; white blood cell count, 12,200 per cu. mm.; neutrophils, 82 per cent; lymphocytes, 17 per cent; mononuclears, 1 per cent; blood sugar, 82 mg. per 100 cc.; blood urea, 30 mg. per 100 cc.; urinalysis: specific gravity, 1.025; albumin, faint trace; red blood cells, 2 plus; occasional white blood cell; Wassermann, negative.

The following reports were sent by the referring physician:

The colon filled with difficulty owing to spasticity of the bowel. One point is noticeably narrowed probably from pressure near the splenic flexure. An area just proximal to the splenic flexure is compressed. The bowel beyond this point appears normal. The coils of the intestines seem to move over the anterior surface of the mass. The splenic flexure is not depressed.

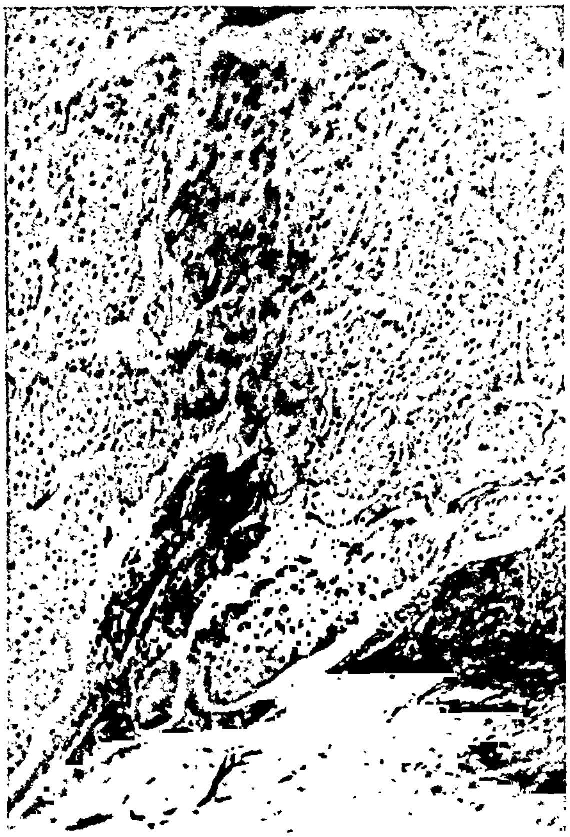

Fig. 4. Microscopic section of adenoma of left kidney.

The intravenous urogram shows the right kidney to be normal. There is marked impairment of function of the left kidney which is poorly visualized.

The retrograde pyelogram shows the left kidney to be depressed. The kidney pelvis and the lower major calyx and calyces are well visualized. The medial and upper calyces are not well outlined.

Diagnoses: (1) Tumor of left kidney; (2) adenoma of thyroid.

A left nephrectomy was performed February 23, 1933. Convalescence was uneventful, and the patient was discharged from the hospital fifteen days later.

The pathologic report was as follows: Specimen consists of left kidney weighing 1,115 Gm. It is greatly enlarged and distorted by a well encapsulated, nodular, globular tumor mass which has replaced the upper half of the kidney. The tumor mass measures approximately 14 cm. in diameter. On cut section the tumor is made up of varying sized lobules of pale yellowish, extremely soft and pliable, cellular tissue, which bulges on the cut surface. These lobules surround a large central area of yellowing, caseous tissue in which there are several areas of hyaline scarring. This area on cut section measures 9 by 5 cm. The tumor appears to arise from the hilar portion of the upper pole. The portion of the normal kidney remaining measures 11 by 6 by 6 cm. On cut section this portion of the kidney shows well demarcated anatomic markings and appears grossly normal. The pelvis and 5 cm. of the ureter appear normal.

Microscopically, (Fig. 4) the section of the kidney shows much fibrous tissue sclerosis of a few glomeruli, a few small scars, and localized areas of lymphoid infiltration. Other sections show an encapsulated tumor composed of solid masses and cords of large vacuolated cells having clearly defined cell borders, large quantities of cytoplasm and relatively small, deep-staining nuclei without mitotic figures. The cell masses have no central lumina. There is no papillary growth, no palisading of cells around blood vessels. In some sections are large areas of ischemic necrosis. Sections stained with scarlet red show no fat in the tumor cells.

Diagnosis: Adenoma of left kidney.

On October 15, 1943, approximately ten years later, the patient was living, well, and free of symptoms.

Case v. A machinist, aged twenty-nine, entered the Clinic, August 18, 1942, complaining of blood in the urine. On January 1, 1942, he had observed bright red blood in the urine. The bleeding had continued for one week and then had subsided. It had recurred intermittently since that time and was becoming more pronounced. One month previously he had experienced a severe attack of pain in the right flank. The pain had radiated toward the groin and right testicle. In the past month he had experienced five such attacks lasting up to twelve hours. After the pain had subsided, the urine again had become clear.

The physical examination revealed a well developed man twenty-nine years of age. A large mass was palpable just below the costal margin in the right kidney region, extending posteriorly into the flank. It was smooth, movable, and slightly tender to deep palpation.

Laboratory studies revealed the following: Red blood cell count, 4,400,000 per cu. mm.; hemoglobin, 84 per cent; white blood cell count, 7900 per cu. mm.; neutrophils, 50 per cent; eosinophils, 2 per cent; lymphocytes, 43 per cent; monocytes, 5 per cent; blood sugar, 84 mg. per 100 cc.; blood urea, 30 mg. per 100 cc.; urinalysis: specific gravity, 1.024; Ph. 6; albumin, plus; sugar, 0; microscopic, many red blood cells, occasional white blood cell.

The initial roentgenogram showed a normal lumbosacral region. The left kidney was normal in size, shape, and position. In the right renal area was a large mass of regular outline. A retrograde pyelogram revealed hydronephrosis of the right kidney. There was a deformity of the caudal calyx and a large mass in the lower pole of the right kidney.

Diagnosis: Tumor of the right kidney.

A right nephrectomy was performed August 20, 1942.

Convalescence was uneventful, and the patient was discharged from the hospital fifteen days later.

The pathologic report was as follows: The right kidney weighs 607 Gm. A thin capsule strips with ease from the entire surface and reveals in the upper half of the kidney normal parenchyma, which is smooth and pale. The lower half of the kidney shows a smooth surface but no normal parenchyma. Just beneath the surface are numerous dilated veins. There are three small nodules on the anterior surface of the lower pole. (Fig. 5.)*

On the posterior surface near the hilum are scattered areas of black pigment. On longitudinal section the kidney shows a well encapsulated tumor mass measuring 11 cm. in the greatest diameter. In the center is a small area of necrosis 1.5 cm. in diameter. About this area is thickened, fibrous tissue which at one point in the wall contains a deposit of calcium. The tissue appears edematous but shows no areas of cystic degeneration adjacent to the tumor capsule. There is a thin layer of compressed kidney tissue, otherwise the tumor occupies the entire lower half of the kidney. The pelvis of the kidney is moderately dilated.

Microscopically the section shows an encapsulated tumor of uniform type composed of masses of large cells with considerable vacuolated and granular cytoplasm with finely divided lipoidal material in many tumor cells. The masses of turm ocells are separated by capillaries. There is very little degenerative change. The histologic picture is practically identical with that of some cortical adenomas found in the adrenal gland. I do not believe this is the usual type of hypernephroma frequently encountered in the kidney.

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* The three small nodules on the anterior surface of the lower pole in the gross description are knobby protuberances of the intrarenal tumor beneath the capsule of the tumor and are not secondary or metastatic nodules.

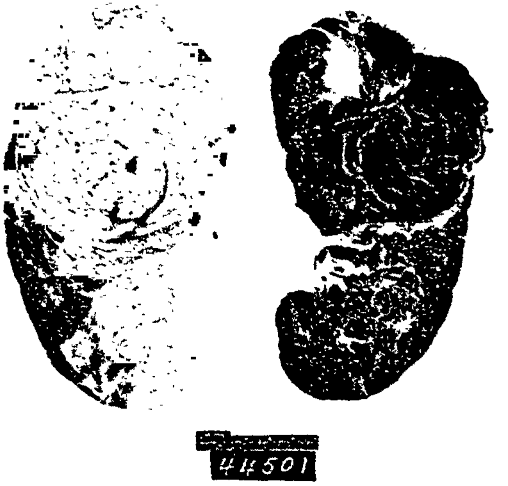

Fig. 5. Gross specimen of adrenal cortical adenoma of right kidney.

Diagnosis: Adrenal cortical adenoma of the right kidney.

When last seen on December 4, 1942, the patient was free of symptoms.

Case vi. A woman, forty-four years of age, entered the Clinic on April 10, 1943, complaining of a constant dull pain in the right kidney region and of high blood pressure of four years' duration. For four months she had complained of a constant dull ache in the right kidney region, and her referring doctor had palpated a large mass in this area. No other urinary symptoms were evident.

Physical examination revealed a well developed and well nourished woman. The blood pressure was 196 systolic and 115 diastolic. Pulse rate was 81. A large mass the size of a grapefruit was present in the right renal area. It was smooth, movable and not tender.

Laboratory studies revealed the following: Red blood cell count, 4,280,000 per cu. mm.; hemoglobin, 80 per cent; white blood cell count, 11,100 per cu. mm.; blood sugar, 88 mg. per 100 cc.; blood urea, 33 mg. per 100 cc.; urinalysis: specific gravity, 1.025; albumin, faint trace; sugar, 0; few red blood cells: rare white blood cell; Wassermann, negative.

The initial roentgenogram showed a normal left kidney. There was a large tumor at the lower pole of the right kidney.

Diagnosis: Solitary cyst at lower pole of the right kidney.

A right nephrectomy was performed on April 12, 1943. The patient was discharged from the hospital sixteen days later.

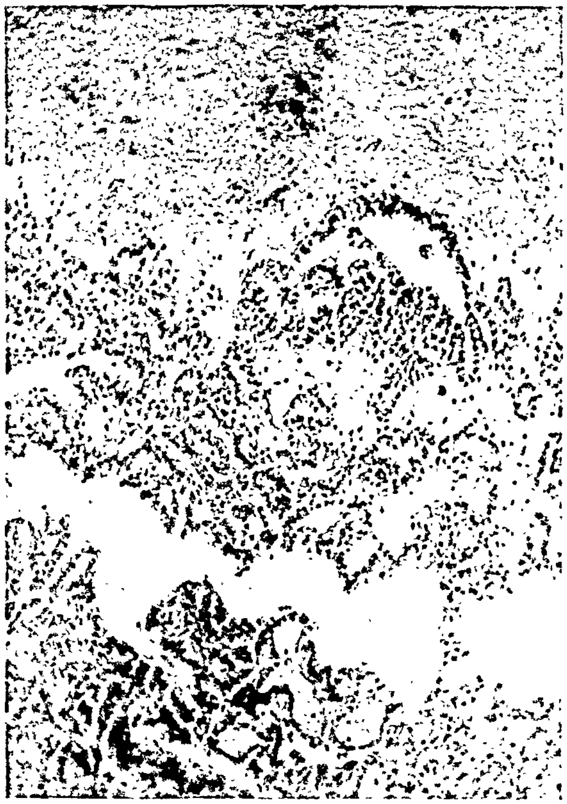

Fig. 6. Microscopic section of degenerating cystic adenoma of kidney.

The pathologic report was as follows: The specimen consists of the right kidney weighing 325 Gm. At the lower pole is a large encapsulated, cystic tumor mass about 3 cm. in diameter which on section is found to be filled with thick, flaky, grumous fluid, rich in cholesterin crystals with a large amount of necrotic tissue covering the inner lining of the cystic tumor. There is little or no identifiable, undegenerated solid tumor. There are no other tumors in the kidney. The pelvis and calices are slightly dilated, but the pelvic membrane and the short segment of ureter are grossly normal. Near the upper pole of the kidney is a small amount of arteriosclerotic scarring.

Microscopically, (Fig. 6) the sections show a well encapsulated type of growth with extensive degenerative changes and no definite histologic evidence of malignancy or gross or microscopic evidence of malignancy as indicated by local invasion of capsule, kidney tissue, or blood vessels. The histologic characteristics of the tumor, apart from the degenerative changes, suggests its origin from renal tubules, and it is similar in general type to the small cortical adenomas so frequently occurring in arteriosclerotic kidneys.

Diagnosis: Degenerating cystic adenoma of the kidney.

REVIEW OF THE LITERATURE

In 1927, Judd and Simon[2] cited seven cases from the literature and added an additional case. In 1929, in a similar review Kretschmer and Doehring[3] added a case to bring the total to seventeen. Table I presented by Carver[4] included the cases up to 1935 but omitted that reported in 1931 by Creevy.[5] The total to date, therefore, including the six cases herein reported is twenty-nine. As two cases previously reported were found accidentally at postmortem examination, only twenty-seven cases of benign adenoma of the kidney have been treated surgically.

Age. The age incidence is very inconstant as well as inconspicuous in the range; the youngest patient on record was an eleven month old girl (Czerny).[6] Kynoch[7] reported an adenoma of the kidney in a child sixteen months of age. The oldest patient was a man seventy years of age (Binney).[8]

Sex. Benign adenoma of the kidney occurs with almost equal frequency in both sexes. In the cases in which the sex was indicated, thirteen occurred in women and eight in men. Four of our patients were women and two men.

Clinical Data. As stated by Kretschmer,[3] the majority of cases were reported before patients were carefully studied by roentgen ray, cystoscopy, ureteral catheterization, and pyelography. Likewise, in those cases observed at postmortem examination clinical data were not available.

The one constant symptom was the presence of an abdominal tumor. In the cases cited by Carver[4] a tumor was present in nineteen of twenty-two cases. A tumor was not palpable in the case cited by Creevy.[5] The tumor was palpable in five of our six cases; in four on the right, and in one on the left.

Pain. Of the twenty-two cases collected by Carver[4] pain was a symptom in eleven. Creevy's[5] patient also complained of pain in the left renal area. All of our six patients experienced pain. The pain varied from a dull aching pain to severe attacks of colic associated with hematuria and the passage of clots requiring morphine for relief.

Hematuria. In the twenty-two cases collected by Carver[4] hematuria was present in eight instances. Hematuria was present in five of our six cases and in that cited by Creevy.[5] The blood may be discernible only on microscopic examination of the urine, or the patient may observe gross hematuria and the presence of clots in the voided urine.

Before the introduction of pyelography the diagnosis was established by exploratory operation; now the diagnosis of a renal tumor may be made by retrograde pyelography. In all six cases in this series a definite filling defect was demonstrable on the pyelogram. Likewise, in the case observed by Creevy[5] a filling defect was evident. In the twenty-two cases cited by Carver[4] a filling defect was demonstrated in the pyelogram in four instances.

Size. Adenomas vary from a millimeter in diameter to over 20 cm. in diameter. (Table I.) Large tumors are usually noted in patients past middle life. However, Czerny,[6] Kynoch,[7] Morris,[9,10] and Schonbron[11] reported palpable tumors in children under three years of age.

The histogenesis of these tumors is not clear. At postmortem study arteriosclerotic kidneys are frequently found to be the seat of multiple adenomas. Ewing[12] has stated that the papillary cystadenomas frequently observed in arteriosclerotic kidneys are secondary to vascular occlusion. The frequent association of adenomas and arteriosclerosis of the kidneys has been mentioned by Kaufmann,[13] Metzner,[14] and Sabourin.[15] Turley and Steel[16] have sought to trace the origin of adenomas to the

TABLE I

ADENOMA OF KIDNEY—LIST OF PUBLISHED CASES

No.	Author	Sex	Age	Side	Pain	Hem-aturia	Tu-mor	Urine	Pyelogram	Operation	Diagnosis	Result	Remarks
1	Albert	F	42	R	+	+	+	B & P	....	Nephrectomy	Papillary adenoma	Recovered	
2	Bell	F	39	R	..	..	+	......	....	Nephrectomy	Alveolar	Died—16 hours	13 by 10 by 7.5 cm. 650 Gm. in weight
3	Binney	M	70	L	+	..	+	Neg.	....	Nephrectomy	Adenoma	Recovered	
4	Czerny	F	1 1/12	L	..	+	+	......	....	Nephrectomy	Adenoma	Died—2 days	Peritonitis
5	Foules and Braasch	M	48	L	..	+	+	......	....	Nephrectomy	Adenoma	Recovered	12 cm. in diameter
6	Judd	F	51	R	+	+	+	......	Filling defect	Nephrectomy	Adenoma	Recovered	13 by 11 by 5 cm.
7	Keyes	M	49	R	..	+	+	......	....	Nephrectomy	Alveolo papillary adenoma	Recovered	Nodular growth
8	Kretschmer	F	24	R	..	..	+	R.B.S.C.	Dislocation of pelvis and filling defect	Resection	Adenoma	Recovered	Diminished renal function on that side
9	Kynoch	..	1 9/12	R	..	..	+	......	....	Nephrectomy	Adenoma	Recovered	5 by 5 by 6.5 cm. Posterior part of kidney: size of lemon
10	Morris	M	48	R	+	+	+	......	....	Nephrectomy	Adenoma	Recovered	Anterior surface: lobulated and encapsulated
11	Morris	F	35	R	+	+	+	......	....	Nephrectomy	Adenoma	Recovered	
12	Morris	F	46	..	+	..	+	......	....	Anterior nephrectomy	Tubular	Recovered	Size of cocoanut
13	Morris	M	55	..	..	..	..	......	....	....	....	....	Autopsy specimen—no data
14	Morris	F	3	..	..	..	+	......	....	Nephrectomy	Adenoma		
15	Norman	M	53	..	..	..	..	......	....	....	Alveolar	....	Autopsy specimen—no data
16	Schonbron	..	2	..	..	..	+	......	....	....	Adenoma	Recovered	
17	Weir	M	35	L	+	+	+	......	....	Transperitoneal nephrectomy	Adenoma	Recovered	
18	Faucett	M	..	L	+	..	+	......	Filling defect	Nephrectomy	Congenital cystic adenoma	Recovered	
19	Gordon-Taylor	F	20	L	+	..	+	......	....	Nephrectomy	Adenoma fibroma	Recovered	13 by 11 by 5 in. 22 lb. in weight
20	Cabot	F	45	R	+	..	+	......	Filling defect	Anterior nephrectomy	Cystic adenoma	Recovered	20 cm. in diameter
21	Garceau	F	54	L	+	..	..	......	....	Nephrectomy	Papillary cystic	Died	Size of fetal head
22	Nitch	F	56	L	..	..	+	......	....	Resection	Papillary adenoma	Recovered	✓ Big hemorrhages in several places containing large particles of iron
23	Creevy	F	24	L	+	+	..	R.B.C.	Filling defect	Nephrectomy	Adenoma	Recovered	Tumor 3 cm. in diameter
24	Higgins	F	47	R	+	+	..	R.B.B.	Filling defect	Nephrectomy	Tubular adenoma	Recovered	Tumor 4.2 by 3 by 2 cm.
25	Higgins	M	40	R	+	..	+	......	Filling defect	Nephrectomy	Cystic adenoma	Recovered	16.5 by 16.5 by 11.5 cm.
26	Higgins	F	45	R	+	+	+	R.B.C.	Filling defect	Nephrectomy	Adenoma	Recovered	408 Gm.
27	Higgins	F	40	L	+	+	+	R.B.C.	Filling defect	Nephrectomy	Adenoma	Recovered	1,115 Gm. 14 cm. in diameter
28	Higgins	M	21	R	+	+	+	R.B.C.	Filling defect	Nephrectomy	Adenoma—cystic	Recovered	11 cm. in diameter
29	Higgins	F	44	R	+	+	+	R.B.C.	Filling defect	Nephrectomy	Cystic adenoma	Recovered	8 cm. in diameter

glomeruli. Albarron,[17] however, stated that the precursors of adenomas were islands of imperfectly developed and displaced tubules, originating in some aberration of fusion and observed in many kidneys.

The tumors may be divided into three groups: (1) tubular, (2) alveolar and (3) papillary.

The tumors vary in size from a millet seed to those weighing over 1,000 Gm. They are well encapsulated, grayish red in color, or vary from gray to yellow. The tumor is usually situated in the cortex of the kidney but may be found in the medullary portion. The lesions may be either single or multiple.

Tubular adenomas are not uncommon and consist of long, irregular canals lined with small, fat-free cells with large nuclei. The stroma contains numerous blood vessels. Trinkle[18] mentions four such cases, and this type of adenoma has been described by Ricker,[19] Norman,[20] and others.

The alveolar type, microscopically, reveals polyhedral cells arranged in alveolar fashion. Many of the alveolar spaces are filled with these large cells. The cells frequently contain fat droplets. Microscopically, certain hypernephromas closely resemble alveolar adenomas.

The papillary type seems to develop in a cyst by proliferation of the lining epithelium. Trinkle[18] states that a papillary cyst adenoma is of the solid type when the papillary processes so fill the cyst cavity that no appreciable space remains.

Microscopically, the connective tissue papillae are covered with a layer of cylindrical or cuboidal epithelium, the cells of which may be opaque, small, and granular, or large and clear with granules of doubly refractive lipoid. This is probably the most common type.

The possible relationship between adenomas of the kidney (benign or malignant) and carcinoma (hypernephroma) is an interesting problem. In 1883, Grawitz[21] advanced the theory that hypernephroma of the kidney developed from adrenal rests. This theory was accepted for many years, and although still believed to be the most plausible explanation by some investigators is subject to discussion.

Sudeck,[22] in 1893, disputed the theory propounded by Grawitz[21] and suggested that the Grawitz tumor (hypernephroma) arose from pre-existing adenomas. He strongly emphasized the similarity of the cells in the two types of tumors. Stoerk[23] concurred with Sudeck[22] stating that hypernephromas arose from adenomas of sclerotic kidneys. They stressed (1) the cyst formation associated with arteriosclerotic contracted kidneys followed later by (2) the formation of cyst adenomas and finally hypernephroma.

Creevy[5] cited an adenoma of the kidney presenting a structure similar to hypernephroma, which was also observed in one case in our series. Creevy in discussing the gross and microscopic appearance of the tumor stated:

"The histologic structure corresponds exactly to that of typical hypernephroma or carcinoma of the cortex except that the individual cells are wholly 'benign' in appearance. That is, the nuclei are small; nucleoli are lacking; there are no mitotic figures; the cell margins are distinct; their arrangement is orderly." He concluded, "Nevertheless, one cannot avoid the suspicion that, left to itself, this tumor would in time have developed into a typical malignant epithelial neoplasm of the kidney."[5]

Nicholson,[24] in 1909, reported a case in which a tumor of the kidney removed surgically was diagnosed histologically "carcinoma of the kidney." Six months later a recurrence developed in the operative scar. Microscopic study of the tissue removed at postmortem examination revealed a papillary adenoma. In 1910, Nobiling[25] cited a case in which one kidney was the site of miliary adenomas, while the opposite kidney contained a hypernephroma.

Gray,[26] in 1927, cited a case of kidney tumor found at necropsy in which some areas had the appearance of hypernephroma, in other areas the structures resembled papillary adenomas, while in other areas the cells and their arrangement resembled both tumors. These areas merged imperceptibly with one another.

An unusual type of tumor, which I believe is infrequently encountered, was present in one of our cases. The pathologic report is as follows: *Microscopic:* Section shows an encapsulated tumor of uniform type composed of masses of large cells with considerable vacuolated and granular cytoplasm with considerable finely divided lipoidal material in many of the tumor cells. The masses of tumor are separated by capillaries. There is very little degenerative change. The histologic picture is practically identical with that of some cortical adenomas found in the adrenal gland. Trinkle states, "Presumptive evidence for the origin of hypernephroma from adenomas lies in the fact that very early hypernephromas are seldom found."[18] He had no examples measuring less than 1.5 cm. in diameter. Thus smaller tumors may have the gross appearance of a hypernephroma but belong to the adenoma group. However, the border line between the two groups is arbitrary.

A review of the literature indicates that the age incidence of adenomas and hypernephromas is quite similar, and that both occur with increasing frequency with advancing age.

As has been mentioned previously, adenomas arise in kidneys which are the seat of vascular disease being most frequently observed in arteriosclerotic kidneys. On microscopic examination some of the large tumors of the papillary type reveal areas very closely resembling hypernephromas of the kidney. The gross appearance and the site of the tumor may be of an adenoma, while the histologic character may be indistinguishable from that of a hypernephroma. Such observations suggest a close relationship between carcinoma of the kidney and adenoma.

Treatment. Large adenomas of the kidney should be removed surgically. In the cases reported in the literature nephrectomy was performed in twenty-four instances and resection in two. The transperitoneal approach was utilized in three cases, and the lumbar incision was employed in the remainder. In some instances a resection may be justified, but the possibility of malignant changes in some part of the tumor should be considered when employing such a procedure.

Mortality. In all six cases in this series convalescence was uneventful, and the patient was discharged from the hospital on an average of fifteen days following operation. In the literature three of twenty-one patients died following nephrectomy. The two patients in whom resection was employed recovered.

CONCLUSIONS

1. Six additional cases of large benign adenomas of the kidney removed surgically are reported.
2. A collected series of twenty-nine large adenomas of the kidney with surgical intervention in twenty-six instances is reviewed.
3. As papillary adenomas of the kidney enlarge, structural changes may occur producing a tumor histologically similar to hypernephroma of the kidney.
4. From available data and histologic study it may be assumed that some malignant epithelial tumors of the kidney develop from papillary adenomas.
5. Large adenomas of the kidney producing symptoms and requiring surgical removal are rare renal tumors.

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In chronic prostatitis there is no residual urine; cystoscopy shows no intravesical projection of the gland and urine analysis determines the nature of the infection.

PILONIDAL CYSTS

SUBCUTANEOUS EXCISION BENEATH DEFINITELY PLACED FLAPS

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THE purpose of this paper is to present what in our hands has been a distinct improvement over our previous method of treating pilonidal cysts. Most of the cysts are infected. We have recently applied to them a type of procedure similar to that used in the treatment of carbuncles of the neck. We have excised them beneath raised skin flaps. This method provides the advantages of an open wound without the disadvantage of slow closure by granulation alone. By placing the incisions in such a manner as to have the bases of two flaps at right angles to the long axis of the body a strong scar is obtained with little probability of future disruption.

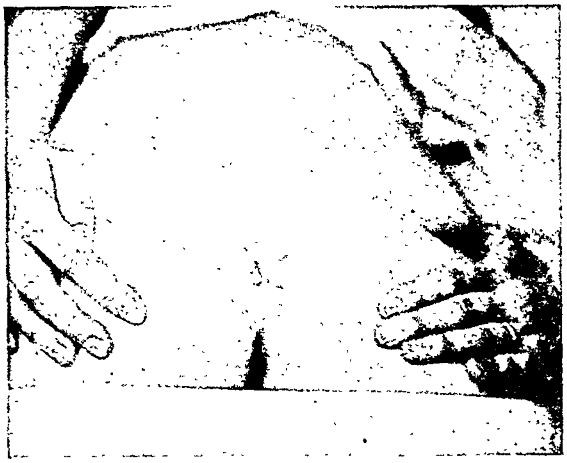

Fig. 1. Operation done May 8, 1943; wound healed June 12, 1943; photographed, June 14, 1943.

A crucial incision is usually sufficient. In one very large cyst with skin necrosis over an abscess two and a half inches from the sinus opening in the skin, five flaps were necessary in order to excise the entire tract without having a linear mid-line scar. The mid-line scar is avoided for two reasons: In the first place healing is slow because of deficiency of soft tissues and circulation. In the second place, such a scar, especially in women with fleshy, mobile buttocks, may disrupt six or eight months after complete healing if subjected to such strains as bicycling or horseback riding.

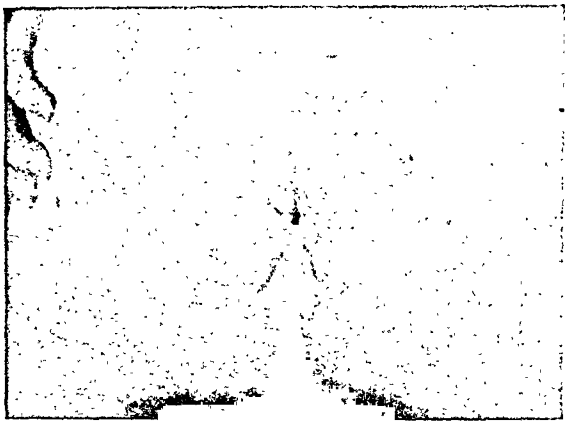

Fig. 2. Operation done June 1, 1943; wound healed and photographed June 24, 1943.

Previously we had tried various methods. Some wounds were closed after excision of the cysts but the percentage of primary union was small. They usually had too much infection for primary closure. Most were excised and left open but the period of healing was too long. In that group during twenty years there has been only one failure to cure at the first operation. That failure appeared to be due to a second cyst not connected with the original and it was later excised. Linear, transverse, oblique and additional relaxing incisions have all been used without satisfaction. In one case of excision through a mid-line incision the wound disrupted from bicycling almost a year after complete healing. Skin flaps were then grafted across the wound to strengthen it.

Dissection of carbuncles beneath raised skin flaps has been used many years with satisfaction. The thought occurred to us that a similar method could be used for infected pilonidal cysts. We tried it and found that it worked well.

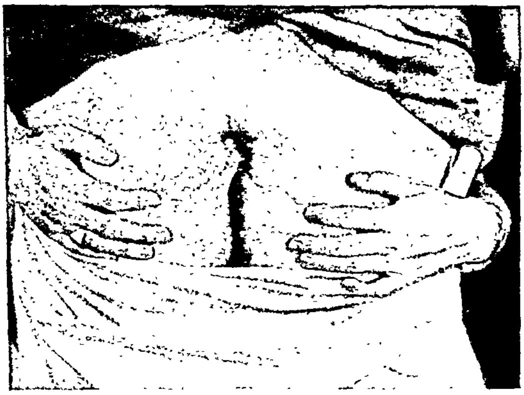

Fig. 3. Operation done June 4, 1943; wound healed and photographed July 7, 1943.

Technically, we have modified our ideas as we have had more experience with these cysts. Formerly we injected them with a small amount of methylene blue and peroxide, believing that in this way we could better identify tissue for excision. Latterly it has appeared a mistake. The tissues are probably better identified unstained. In the making of the skin flaps care should be exercised to avoid incisions in the mid-line or long axis of the body. Healing is slow in the mid-line and disruption more liable to occur. Frosting the wound with sulfanilamide powder is useful —frosting, not caking or packing. The skin flaps can often be sutured together and to the bottom of the wound to advantage. A loose purse-string suture at the apex of the flaps, arranged so as to leave only about a quarter inch opening will sometimes prevent retraction and still allow adequate drainage. Pressure on the wound is useful when it is healing cleanly.

If the purpose of the operation is kept in mind, its variations to suit different circumstances become readily apparent. It is designed first, to obtain the safety and sureness of open wound healing; second, to reduce the length of time required in such healing by utilizing all healthy tissue available; and third, to provide a strongly healed wound without the disadvantage of a mid-line scar. (Figs. 1 to 3.)

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RECONSTRUCTIVE SURGERY OF THE NOSE IN CONGENITAL DEFORMITY, INJURY AND DISEASE*

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FROM Tagliacozzi[35] to Joseph,[15] reconstruction of the nose has interested the plastic surgeon more than any other aspect of the specialty. Updegraff[36] in his classic paper, "The Fall and Rise of Plastic Surgery," indelibly outlined the historical trend. Since the turn of the century, Blair,[2] Gillies,[11] Webster,[38] Sheehan,[28] Brown,[4–7] Smith,[30] Davis,[10] Straith,[33] Pierce[24] and many others have correlated and advanced the knowledge. Whether the deformity be due to trauma, loss of tissue, congenital defects, hare-lip or paraffinoma, a thorough knowledge of anatomy and physiology is presupposed for an understanding and judgment of the required reconstructive surgery.

ANATOMY

The nose is a triangular pyramid with the bridge formed by the two nasal bones and the nasal process of the maxillary bone. The former articulate with each other mesially, with the nasal process of the maxillary bone laterally and with the frontal bone cephalically. Adjoining, below the nasal bones, are the two triangular shaped upper lateral cartilages. The upper part of each anterior border is fused with its fellow of the opposite side and with the anterior edges of the septal cartilage of the nose; but the lower part is separated by a narrow interval between which the septal cartilage is seen. The posterior border is adjacent to the nasal bones and the ascending frontal process of the maxilla. The lower border is attached by fibrous tissue to the lower lateral cartilage.

The lower lateral cartilages are folded around the anterior aspect of the nose forming an arch of the nostril on either side, and with its fellow aids the septum in forming the point of the nose. (Fig. 4.) Its medial crus thus lies below the septum, its lateral portion lies somewhat parallel and is larger and oval in shape, it reaches neither down to the nostril nor backward to the maxilla. The area behind is filled with fatty fibrous tissue in which there are two or three islets of cartilage, named the small cartilages of the ala.

The bridge of the nose is supported by the nasal septum whose chief constituents are the vomer, below and behind, the perpendicular plate of the ethmoid, above and behind, the septal cartilage below and in front. Small portions of other bones take part in its construction. The septal cartilage fills the gap between the vomer and the ethmoid bones and extends forward forming part of the tip of the nose. Above and posterior, it is in juxtaposition with the anterior border of the perpendicular plate of the ethmoid while below and posterior it fits into the groove in the anterior border of the vomer and the nasal crest of the maxilla. Above and anterior, it is in contact with the suture between the two nasal bones, while immediately below it is continuous with the upper lateral cartilages of the nose.

Arterial, Venous and Lymphatic Supply. The external maxillary artery supplies the superior labial and external nasal branches. The ophthalmic artery from the internal carotid sends the infratrochlear, supratrochlear and supraorbital branches.

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* From the Division of Reconstructive Plastic Surgery, Cedars of Lebanon Hospital, Hollywood, and dedicated to its former Chief, the late Dr. Howard L. Updegraff. Presented in conjunction with colored surgical motion pictures at the Los Angeles County Medical Society, April 8, 1943; the Long Beach County Medical Section November 10, 1943; (by invitation) the U.S. Naval Hospital, Yosemite, California January 2, 1944; the Santa Barbara County Medical Society May 8, 1944.

Supplying the septum proper are the anterior and posterior ethmoid arteries from the ophthalmic artery, and the lateral septal branches of the sphenopalatine artery given off by the internal maxillary artery. An anastomosis between the anterior ethmoid artery, the sphenopalatine artery and the superior labial artery forms Kiesselbach's plexus, which often hemorrhages.

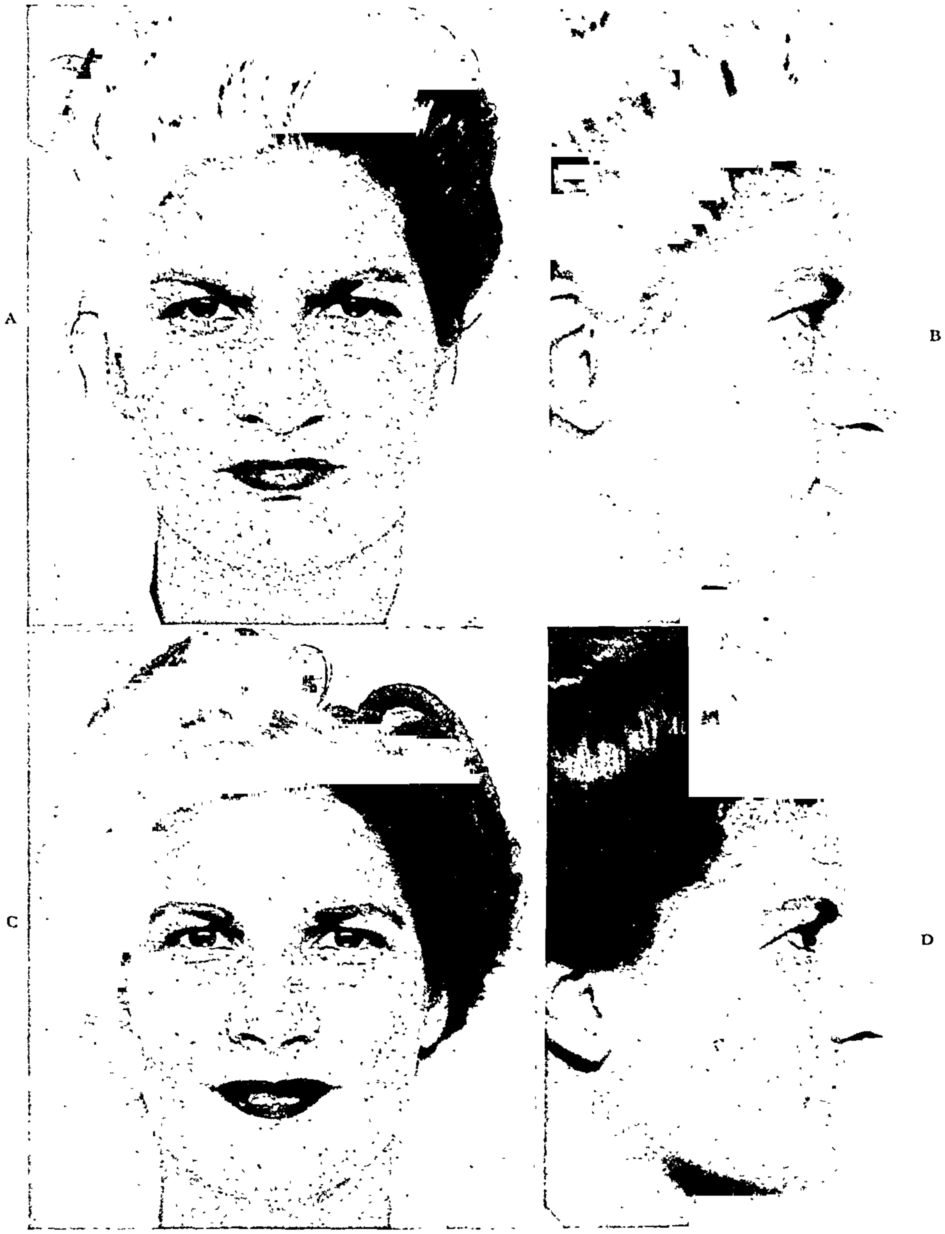


FIG. 1. Old fracture of the nose in conjunction with a congenital deformity. A, before: front view showing the wide bridge, flattened upper lateral cartilages and depression over the septum, with a wide dropped tip; B, before: profile showing the hump, depression and dropped tip; C and D, after rhinoplasty; E, cast taken before surgery for study.

The venous drainage externally is into the anterior facial vein, which joins the internal jugular vein in the neck, and continues with the angular vein joining the superior ophthalmic vein, a tributary of the cavernous sinus of the skull. Within the nose, the blood drains superiorly into the ethmoid veins, anteriorly into the facial veins and posteriorly into the sphenopalatine veins.

The lymphatics drain externally into the anterior auricular and submaxillary lymph glands, and further to the upper deep cervical chain of lymph glands along the carotid sheath. Within the nasal cavity the lymphatic drainage is backward into the retropharyngeal lymph glands which in turn drain into the deep cervical lymph gland chain.

Nerves. The external sensory nerve supply is derived from the trigeminal nerve, through the ophthalmic division ending in the infratrochlear nerve, and the external branch of the nasociliary nerve, also from the maxillary division ending in the infraorbital nerve.

Internally, supplying the septum are the olfactory nerves for the sense of smell. The following nerves supply common sensation: the sphenopalatine nerve from the ganglion, posteriorly; septal branches of the anterior ethmoid nerve, from the ophthalmic division of the trigeminal, anteriorly; and the anterior palatine nerve, from the ganglion, coming down the pterygopalatine canal, crossing along the hard palate and entering through the foramen of Scarpa in the anterior aspect of the hard palate. The lateral nasal wall derives its supply from the sphenopalatine ganglion which sends the posterior and superior lateral branches of the anterior palatine nerve, while anteriorly it is supplied by the anterior ethmoid nerve from the ophthalmic division of the trigeminal nerve. The vestibule of the nose is supplied by the alveolar branch from the infraorbital nerve, derived from the maxillary division of the trigeminal.

PHYSIOLOGY

Function. The air pressure in the nasal cavity and the sinuses is the same and varies from -6 to $+4$ mm. of water. Thus Proetz[25] has demonstrated that mechanical blockage at the nares, along the nasal passage or at the choana will upset the pressure and subsequently the function.

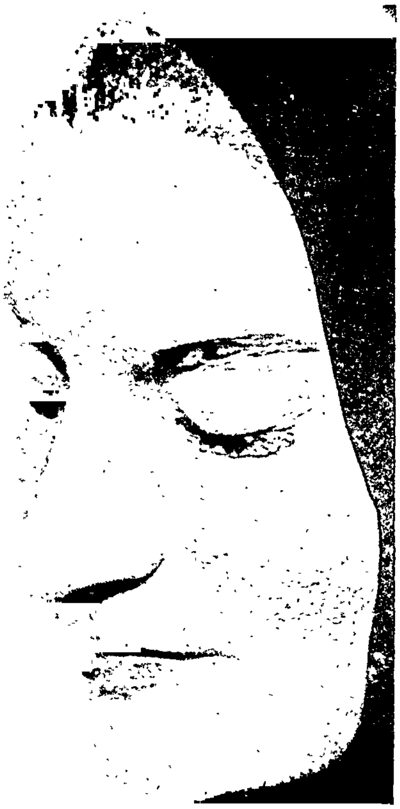


Fig. 1E. For descriptive legend see opposite page.

The air is heated to 34 degrees in its passage through the nasal chambers. It is further moistened and the nasal cavity expends one liter of water daily in performing this duty, which takes 70,000 calories. The nose acts as a filter, catching larger particles on the vibrissae, bacteria and small elements in the sticky mucous secretion. Proetz[25] has demonstrated the principle of impingement and has shown that spurs, a deviated septum and growths such as polyps will act as barriers to the normal passage of foreign material back to the nasopharynx and thence to the stomach to be destroyed by the gastric juices.

Patients, as a rule, do not complain of anosmia until smell is completely gone. Physiological upsets such as occur in allergy have been shown by Hansel[13] to be the cause of temporary anosmia. Protracted infection in the nose which may be due to septal blockage such as that following an injury may upset the entire normal physiology.

The sinuses must be considered part of the nasal vault and act as insulators from cold against the orbit and pituitary, resonators for voice, etc. The air within these sinuses takes many hours to change and in the maxillary sinus, for instance, where there are few glands, the mucosa cannot stand a sudden influx of air.

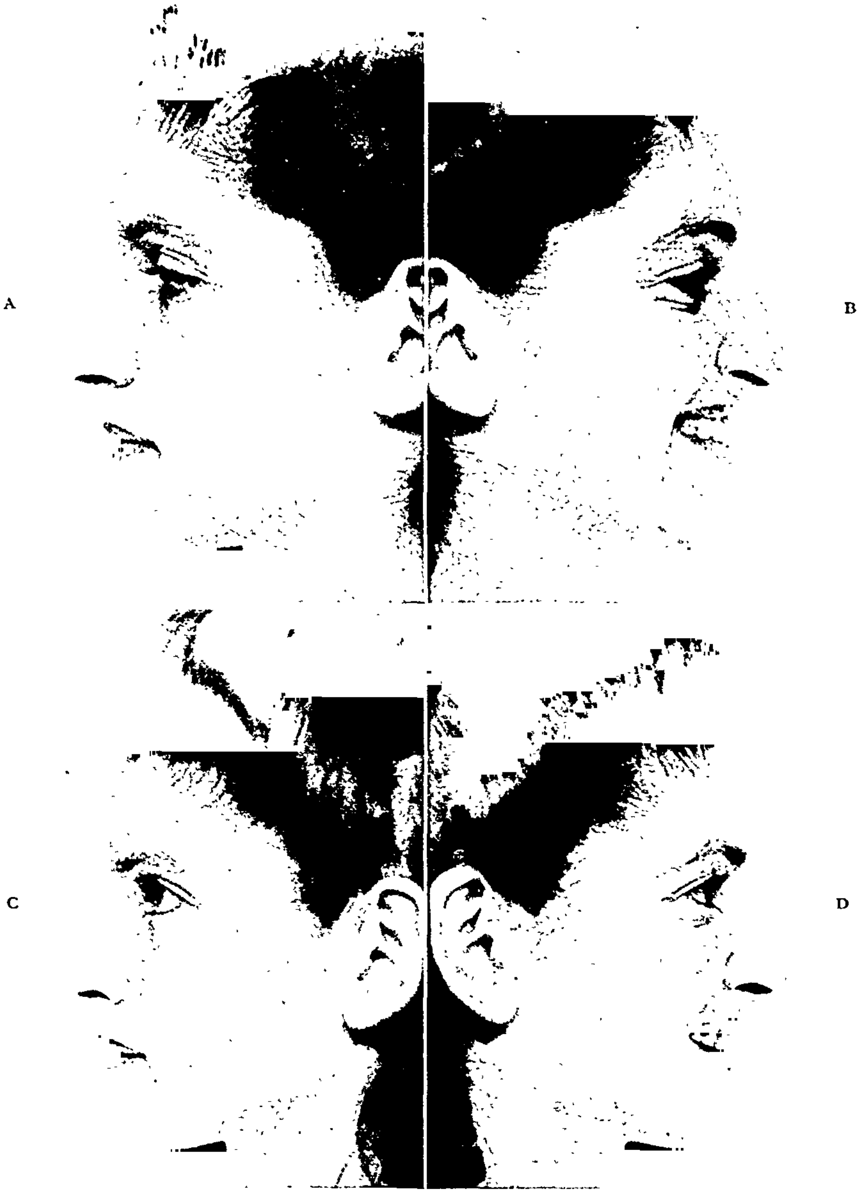
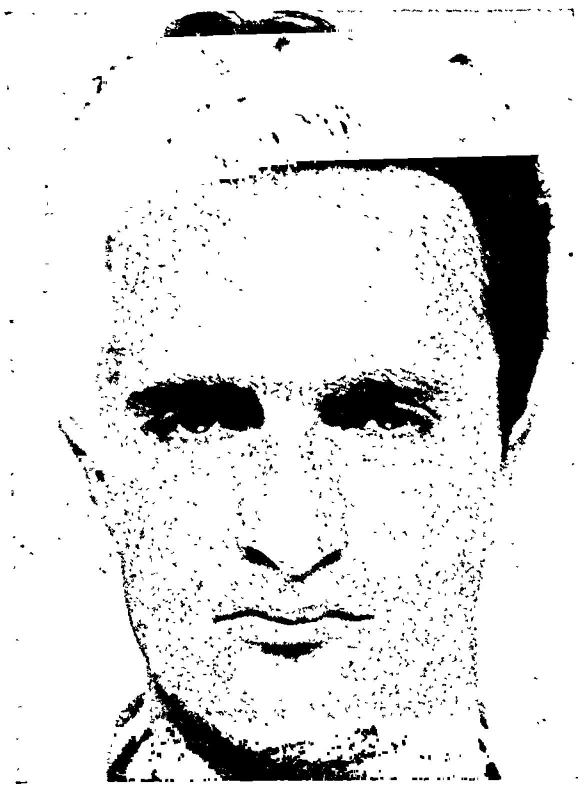
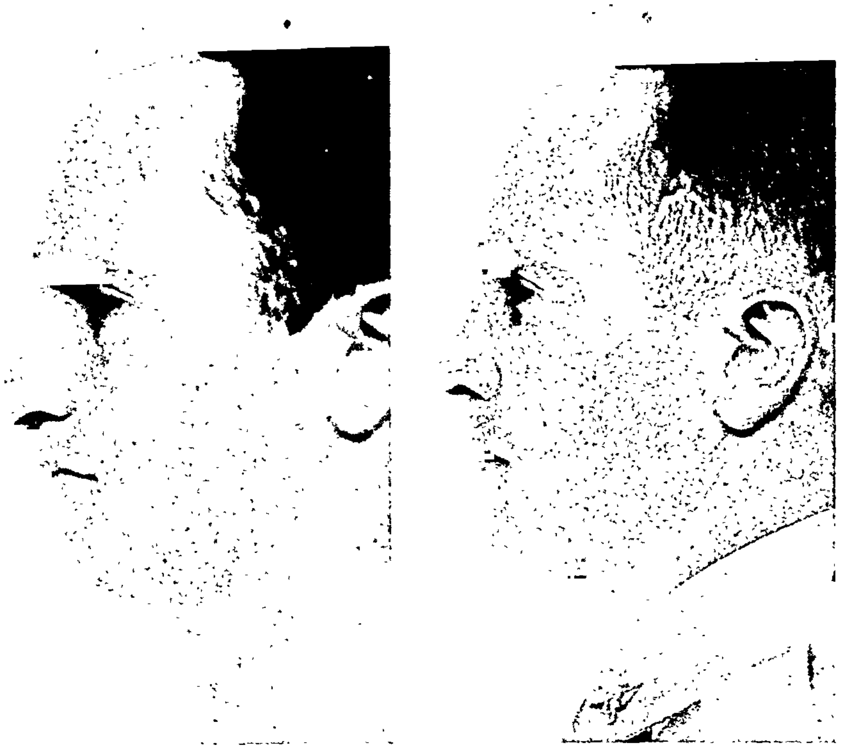


FIG. 2. Congenital beformity of the nose. A and B, before surgery showing hump and dropped tip; C and D, after rhinoplasty.

Mucous Membrane and the Cilia. Commencing at the mucocutaneous junction at the vestibule, the tissue changes from stratified squamous to ciliated columnar epithelium. The cilia are in continuous movement, and are covered with a rather sticky, pliable mucus secretion which acts to catch and hold foreign particles of bac-



A



B C

Fig. 3. Old fracture associated with a congenital deformity. To relieve blockage a thorough submucous resection was done at the time the nose was reconstructed. A and B, before surgery, demonstrating the flattened, twisted nose with a dropped tip and disappearing columella; C, after rhinoplasty.

teria. This mucous blanket covering the cilia is made up of 95 per cent water, 4 per cent mucin, 1 per cent salts, and any change in the mucin content will change the efficiency of the cilia, while drying will slow or stop the ciliary action. It is this barrier, plus phagocytosis, local tissue immunity and natural drainage which are important in the struggle against disease.

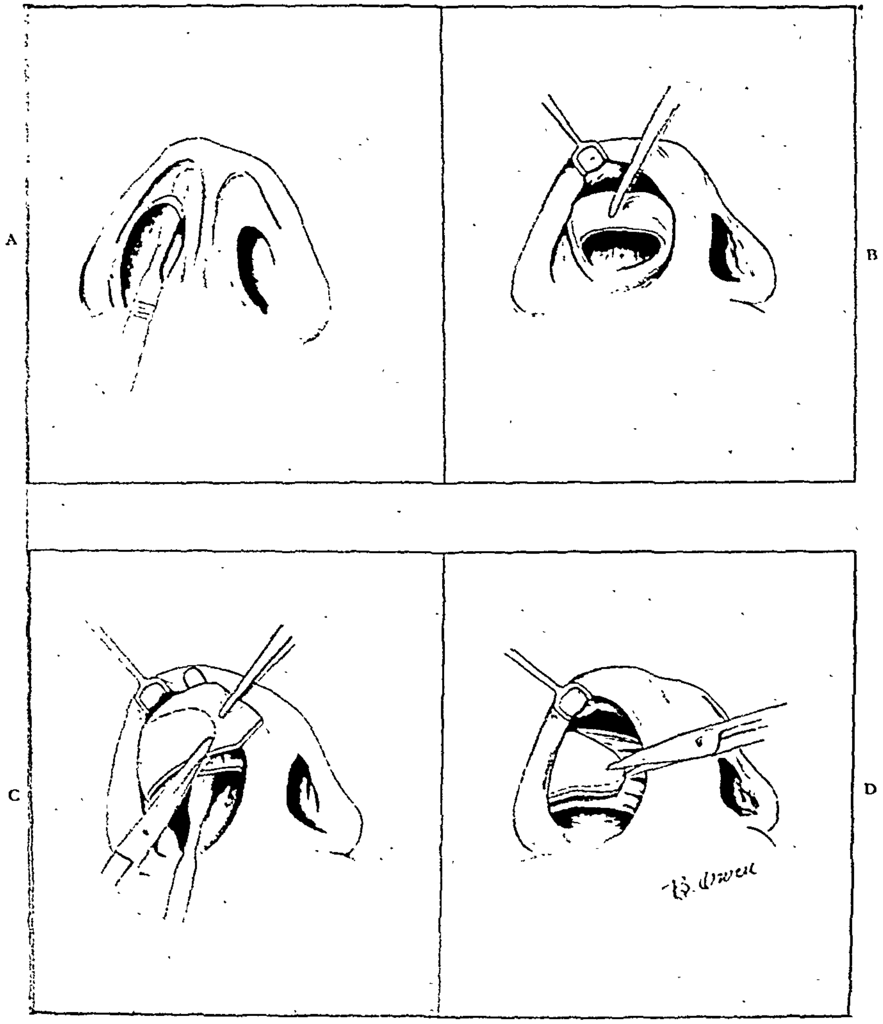


Fig. 4. Demonstrates the technic used in reconstructing the tip. A, incision along lower aspect of lower lateral cartilages connected with upper incision; B, cartilage freed and completely exposed; C, cartilage dissected away from nasal lining and required amount removed; D, excess trimmed from inferior aspect to improve contour of nostrils.

The cilia are some 7 micra long and 1 micra thick, and occur within the nose, the nasopharynx and the larynx. They are ancient structures and consequently appear early in the embryo, and incidentally their activity continues for sometime after death. Specimens from a radical operation show movements of the cilia. The movement of the cilia is upward from the lungs to the pharynx and downward from the nose to the pharynx.

The normal temperature of the nose is 32 degrees and the ciliary action decreases when the temperature drops down to 5 degrees, and further decrease stops the movement. If the temperature is now increased to 18 degrees, the cilia beat very quickly; and if further increased to 43 degrees, the action stops. When the temperature is reduced back to 32 degrees the cilia are no longer viable.

The cilia may regenerate after destruction and will continue to function even in the presence of thick pus. If cilia do not return, they are replaced with fibrosis and bands of adhesions.

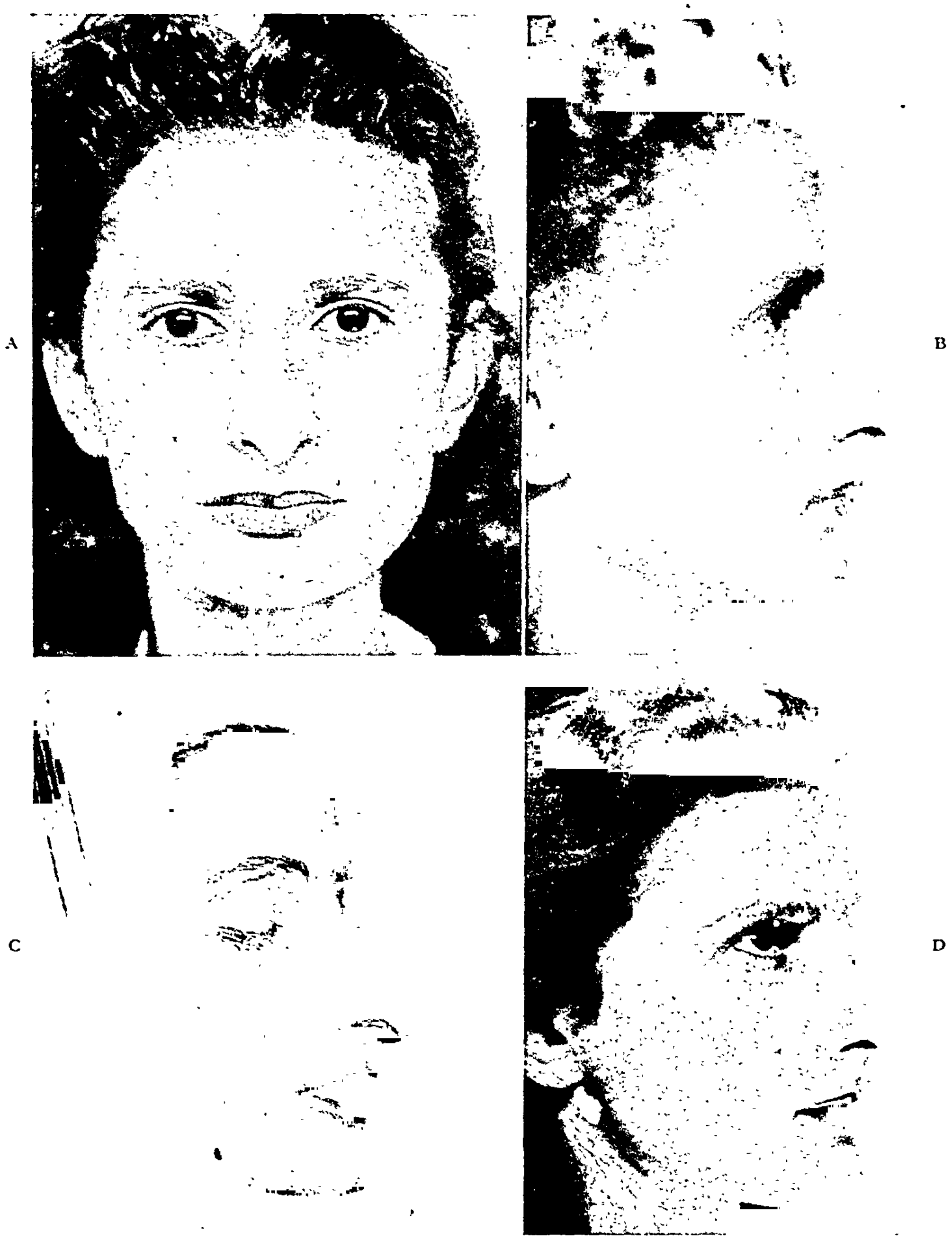


Fig. 5. Congenital deformity with a hump nose, flattened upper lateral cartilages, deformed dropped tip, with a hanging columella. A and B, before; C, cast taken before surgery allows for careful measurements; D, after rhinoplasty.

The effect of drugs and physical agents on cilia are clinically important. *X*-ray in several times the normal exposure does not stop ciliary action. Cocaine and adrenalin are most deleterious to cilia: a 1/10,000 adrenalin solution is borne fairly well but stops them after a time; a 5 per cent cocaine solution may deter action but anything stronger stops movement immediately. Ephedrine, benzedrine and neo-synephrin in physiological saline have very little effect on cilia. Interestingly, adrenalin with ephedrine is less deleterious than when

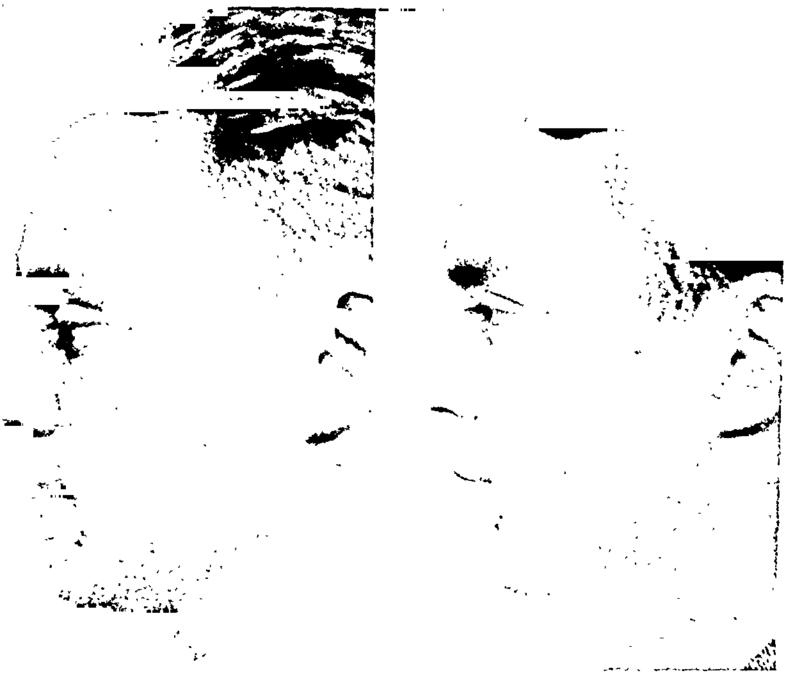


Fig. 6. Saddle nose deformity. A, before, depicting depression over anterior aspect following injury; B, autogenous rib cartilage was used and placed over the depression through an internal incision. The inferior aspect of the cartilaginous strut extended to the nasal spine. Preserved cartilage may be used.

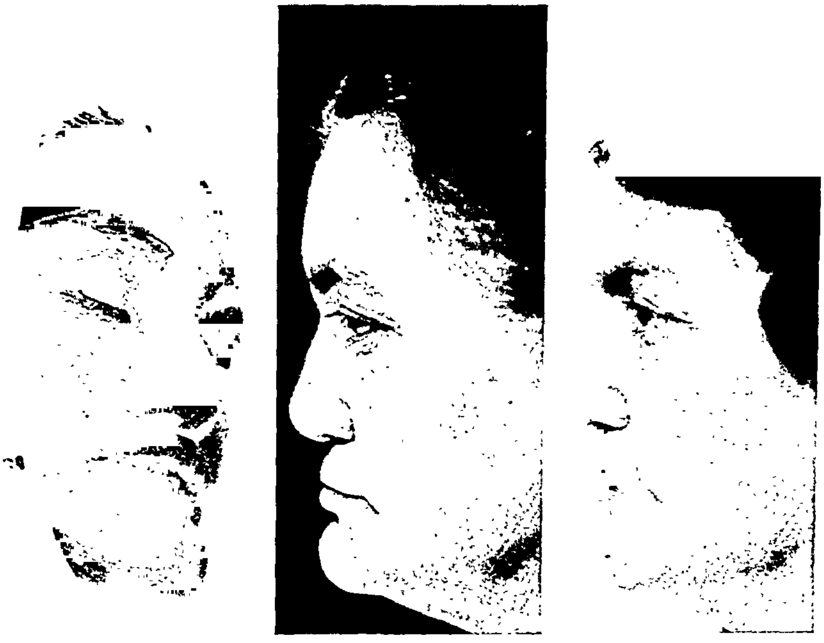


Fig. 7. Flattened nose requiring cartilage transplant through a columellar split incision. A, cast taken before surgery; B, before, showing collapse of the columella with marked retrusion of upper portion of lip; C, after, rib cartilage was taken, carved to a triangular strut and placed beside the septum through a columellar split incision. Anteriorly, the cartilage extended from the nasal spine to the tip and extended up to the glabella. Plate of cartilage placed beneath the upper portion of lip.

used alone. Menthol, eucolyptol and camphor have a mild slowing effect, and have no other beneficial actions. Thymol stops the ciliary movement. Merthiolate and metaphan slow and then stop the action. Mercurochrome retards it. Argyrol markedly effects the viscosity of the surface covering and mechanically interferes with ciliary motion. Oil has caused much controversy and because with no advantages and many disadvantages it should not be used, and all nasal solutions should be made in physiological saline solution. Alcohol in 30 to 35 per cent solution when in physiological saline will not harm the cilia. Tap water will stop them after a time. Gas, ether and chloroform in vapor have no effect on the cilia, but in solution will stop the movement immediately.

Careful cleaning of the nose following surgery is most important. The thick tenacious mucus may be removed with gentle suction, the crusts carefully picked off, thus restoring the normal physiology as soon as possible.

Blockage of the Nose. Many patients seen by the plastic surgeon present problems of mechanical blockage which in turn upset the physiology of the nasal passage. A deviation of the septum may prevent free entrance of air, disturb its pathway back above the inferior turbinate, and also prevent normal drainage of the sinuses. If a submucous resection is necessary, not only should the deviated cartilage be removed, but a goodly portion of the ethmoid plate along with vomer bone and also the maxillary ridge.

Obstruction may be caused by the inferior turbinate. Its usual cause for swelling is allergy, vasomotor rhinitis or a combination. Naturally, the allergens and dust factors as stressed by Hansel[13] should be investigated; but if the patient is not relieved, cauterization should be used. The surgeon may use the actual cautery, electrocoagulation or acid. Personally, we prefer the first method. In any case, the principle should not be forgotten, namely, to streak the turbinate from posterior to anterior surface down to the bone so as to allow the fibrous tissue an anchor with which to retract the mucosa.

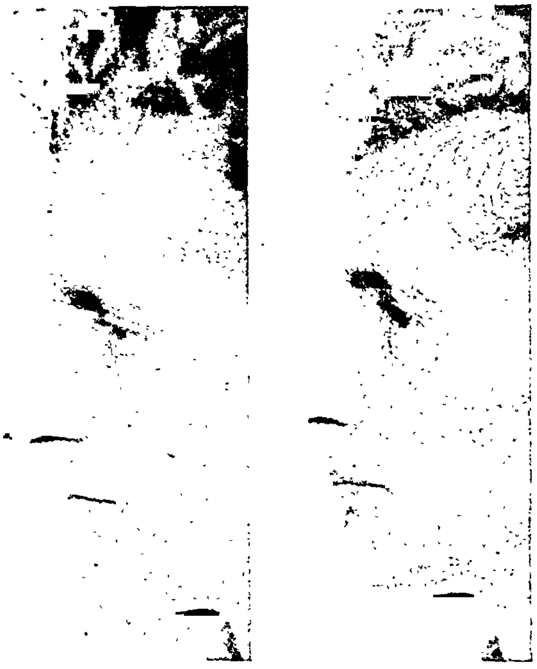


Fig. 8. Old fracture with fragments almost protruding through skin over the bridge; A, before; B, after rhinoplasty.

Polyps, tumors or bony obstruction should be considered and eradicated.

EVALUATION OF CONGENITAL AND TRAUMATIC DEFORMITIES

An exact history pertaining to previous operations and trauma is most important before a thorough examination of the nose both externally and internally.

Points to be considered are the bridge, formed by the nasal bones and the nasal process of the maxillary bones. While the former suffers displacement, over-riding, protrusion and depression, the latter is disturbed much less frequently. The upper lateral cartilages are carefully examined both externally and internally. The lower lateral cartilages, which carry most of the fault in deformity of the tip, are gauged, and the columella is examined.

A most important observation is that of the triangle of the nose as seen when the patient tips the head backward (Fig. 15B) as stressed by Brown.[4] The assymmetry of the lower lateral cartilages may be

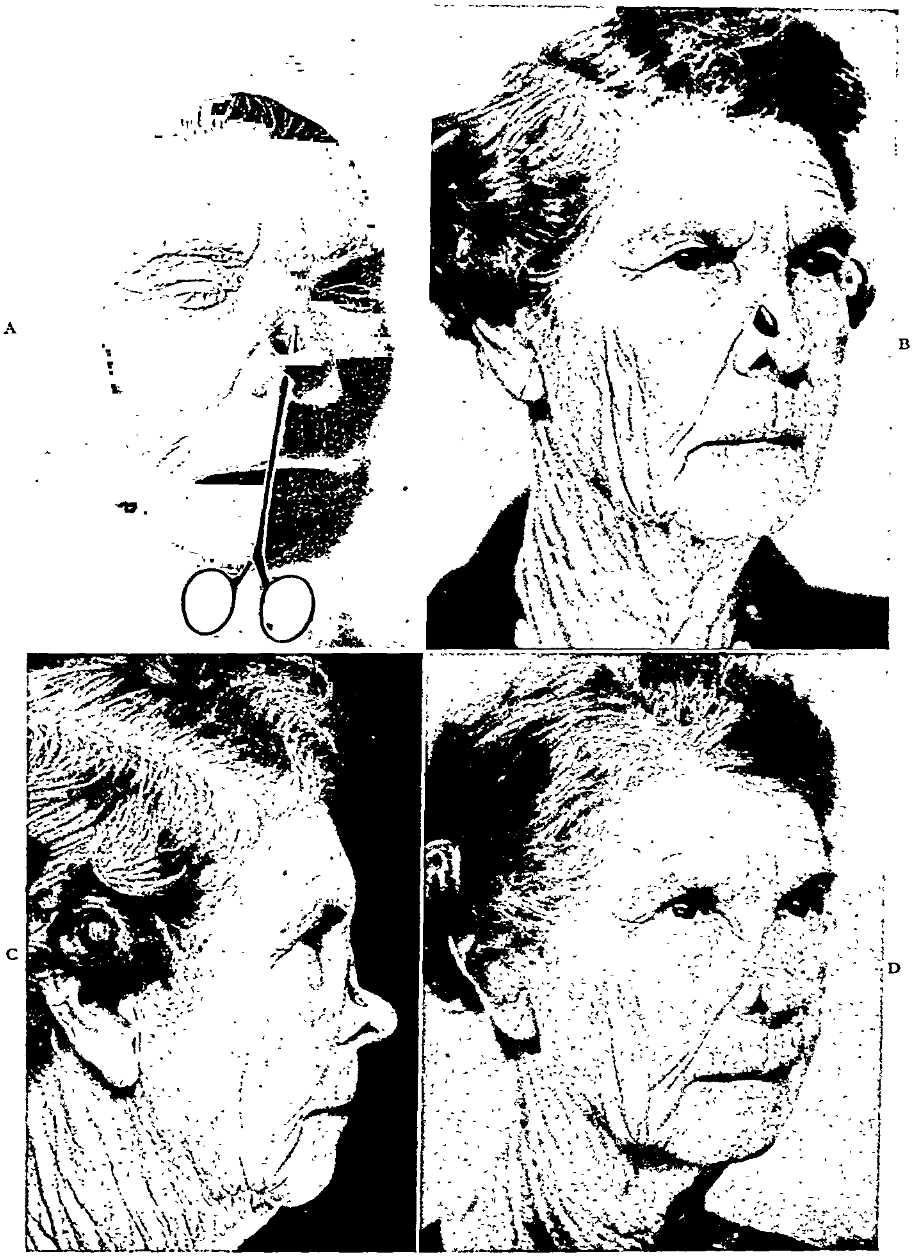


Fig. 9. Cancer of the nose which had been controlled by cautery but the patient lost much of the nose, septum and cartilages when she succumbed to a "professor with cancer paste" four years ago. A, cast, demonstrating the extent of the defect; B and C, before surgery; D, three weeks after surgery; the defect was closed in one stage using the skin around the hole as lining and utilizing nasolabial flaps on either side to cover the whole defect. A section from the anterior tip of the septum was removed and the lower lateral cartilages on both sides were trimmed so as to conform the tip to the flattened bridge. Cartilage will be inserted over the bridge at a later stage.

observed, and also their relation to the columella. Often the septum may be seen encroaching to either side, causing blockage. Sometimes the patient complains of a wide base which often proves to be optical when measurements are taken.

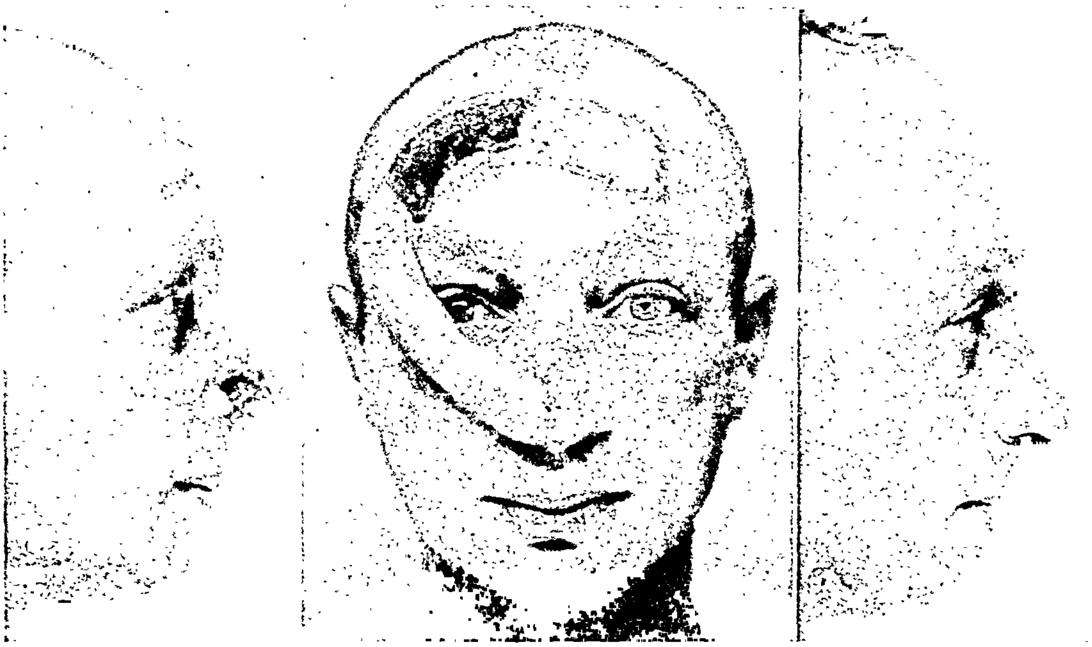


FIG. 10. Cancer of the nose which had been controlled, repaired with a forehead flap. A, defect on nose dissected out, forehead flap raised and lining grafted to the tip of the flap before it was sewn back in place; B, forehead flap raised, tubed and sewn to nasal defect. Thick split skin graft previously applied to forehead has taken and will cover part of defect; C, six months following final stage.

The internal examination is most important and observation of the septum, the turbinates or the presence of polyps, spurs or tumors is noted. If allergy is suspected, a smear of the nasal secretions should be taken.

For a thorough study, careful photographs and a cast of the complete face are made on each case. (Figs. 1, 5, 7, 9, 11 and 13.) Defects that do not meet the eye on initial examination are brought out by these adjuncts. The surgical correction must not only be anatomical, but the result must fit the patient's face. (Fig. 21.)

The plaster cast of the face is made and one side of the nose either marked off or cut down to demonstrate the amount of correction. If the nose is to be reconstructed by the addition of cartilage, clay is used in modeling and from this a pithwood model which can be autoclaved is carved and present during surgery. Postoperative photographs are taken with the same exposure and position so that an honest comparison may be made.

ANATOMICAL ASPECTS OF DEFORMITY

The hump, depression, or assymmetry may be congenital or traumatic. (Figs. 1,3,5 and 22.) The latter may cause unlocking of the nasal bones at the suture line, and with the frontal bone above and the maxillary bone laterally, with an overriding of the edges and resultant deformity. Too, the bones may be fragmented and callous formation may veil the exact anatomical diagnosis.

Upper Lateral Cartilages. These form the body of the nose and with a hump, flare anteriorly; with a broad bridge, they are usually widened and flat; with a depressed bridge, usually following trauma, they are sunken and deviated (Fig. 1A); with an old hare-lip nose, they may be flattened and depressed on the affected side. (Figs. 12, 13 and 14.)

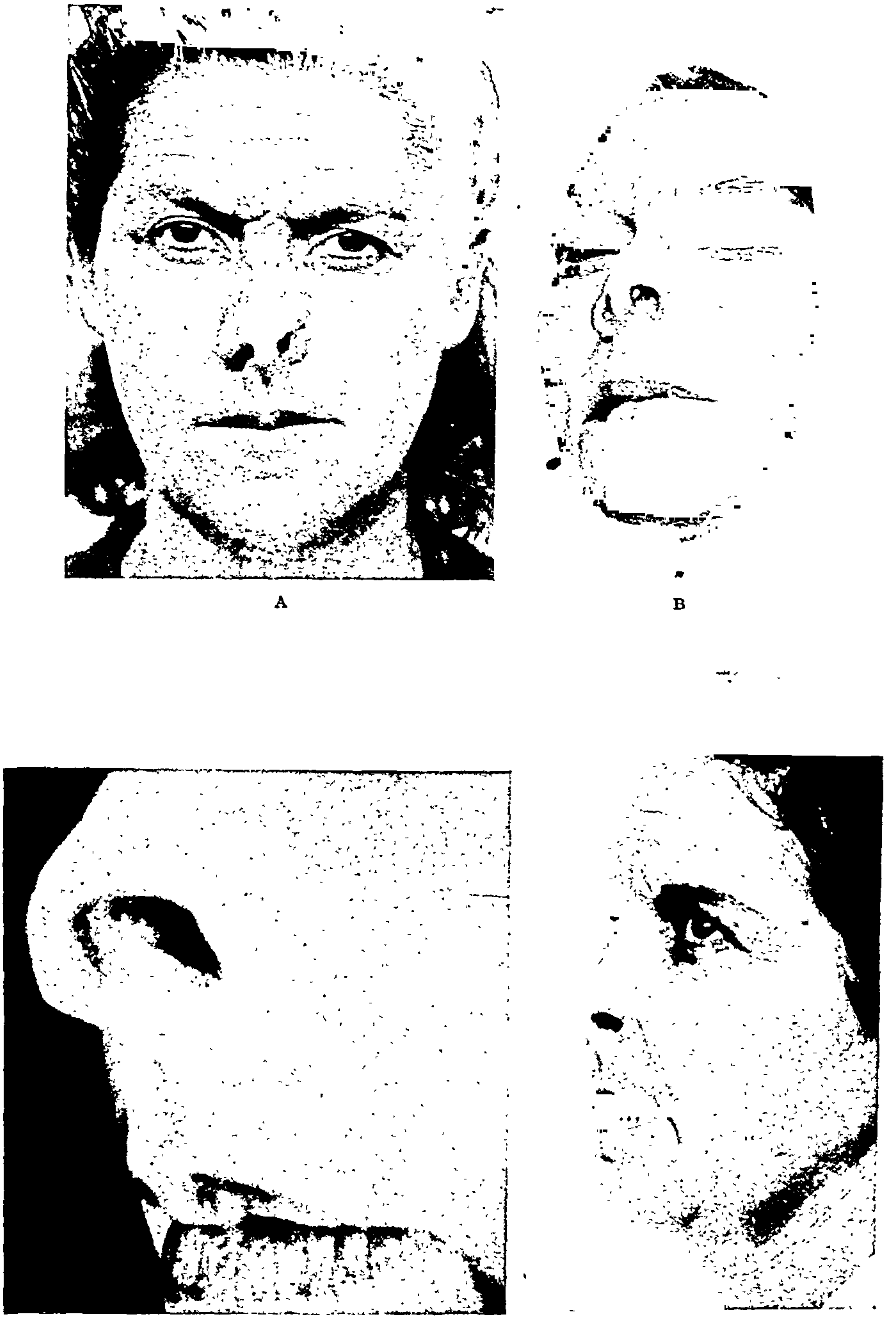


Fig. 11. Injury of the nose with severance of ala on both sides, evulsion of large flap over nose and numerous scars; A, before; B, cast taken before surgery; C, close-up of deformity; D, after rhinoplasty was done first to make the nose smaller and gain tissue. Incision made over the bridge through old scar, the skin was carefully undermined from the mucous membrane lining and reflected downward. A portion of the anterior columella was removed by two V incisions 1 cm. apart. The tip of the nose was formed with the reflected skin from the bridge of the nose. A full thickness graft was taken from behind the ear to cover the defect over the bridge and the former took 100 per cent. Pictures taken eight weeks after surgery with further repair to follow.

The cartilages are usually assymmetrical and so in their growth may cause the nose to twist to one side or the other. It has been noted that obstruction to breathing occurs in cases with long upper lateral cartilages and a dropped tip. The passage is narrowed to the extent that the smallest amount of mucus will close it; this constant barrier upsets the physiology of the nose, preventing normal drainage. Often the patient will make the diagnosis for the doctor by explaining that he is able to breath by grasping the nasal ala on each side with the thumb and forefinger and pulling it out and

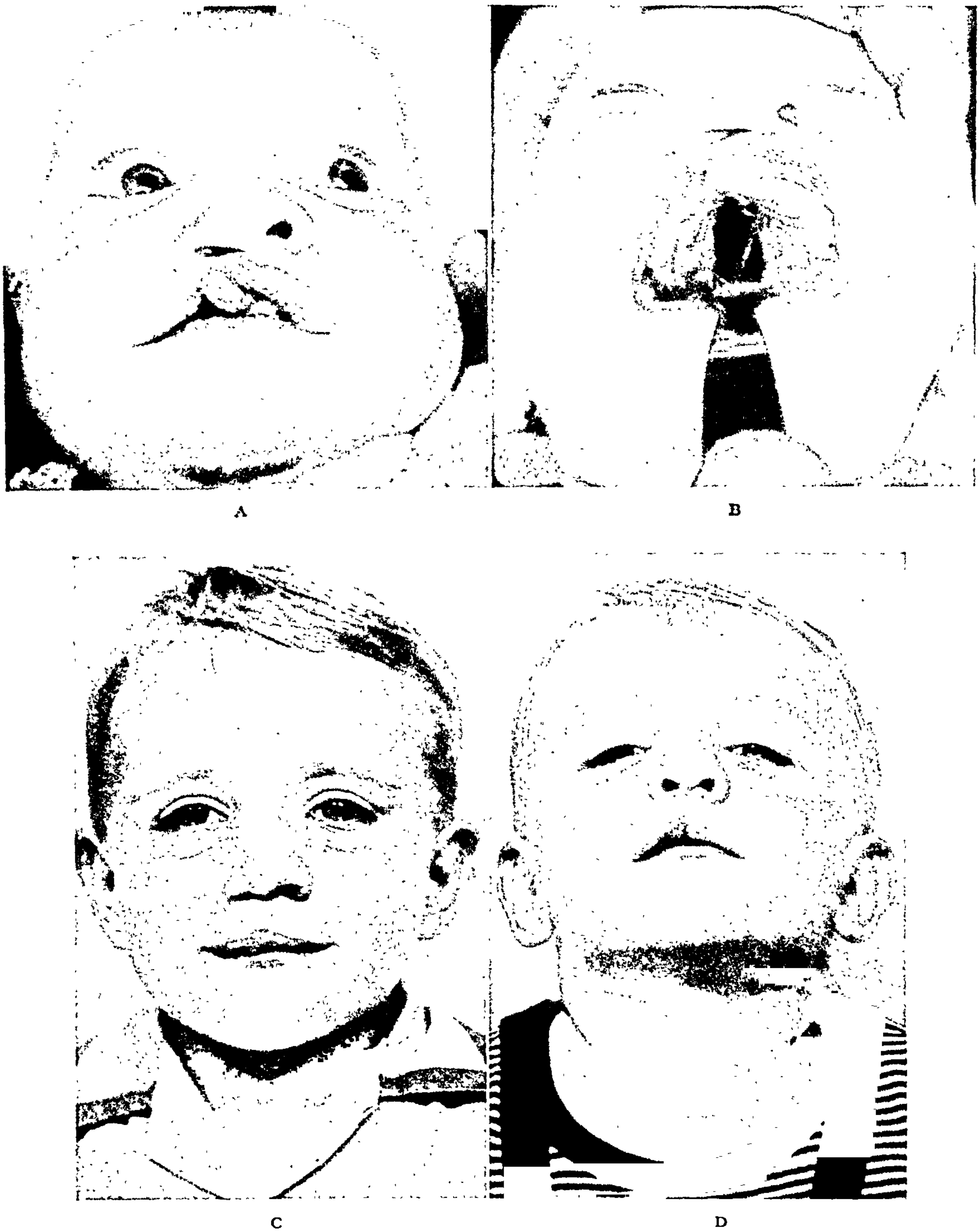


Fig. 12. Hare-lip and nose deformity. A and B, requiring closure of the defect and reconstruction of the ala nasi; C, case three years later showing good protrusion of upper lip and straight base of nose; D, after surgery, lip and vermillion border readjusted; scars removed; ala overcorrected to new position.

up; thus pulling the upper lateral cartilages away from the septum.

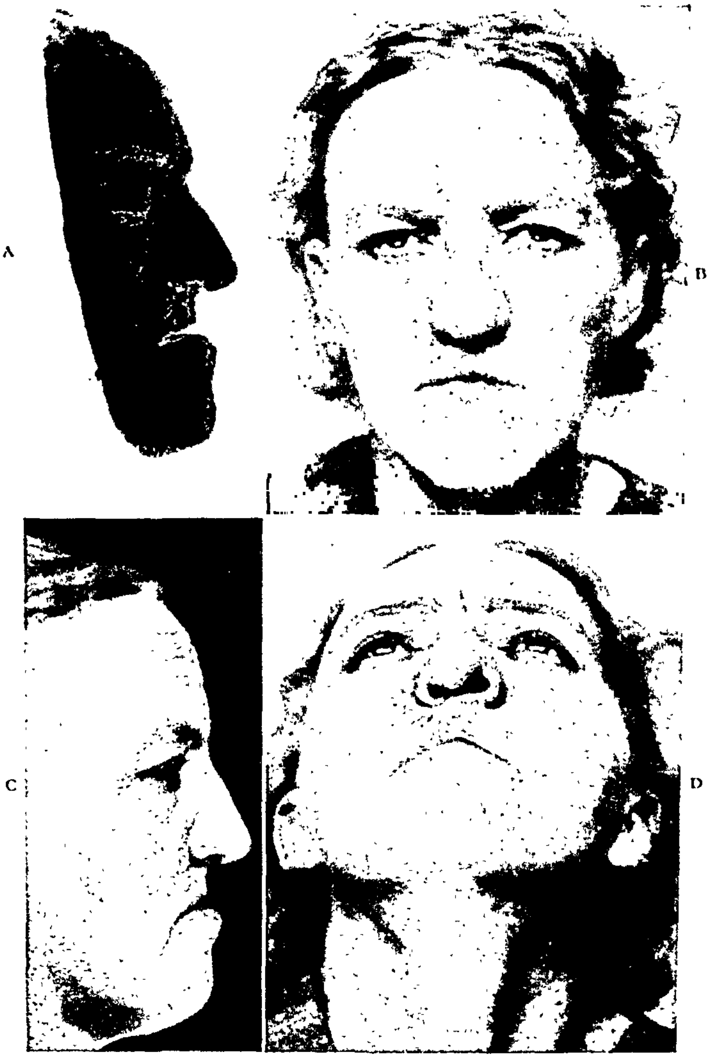


Fig. 13a–d. For descriptive legend see opposite page.

When narrowing a large hump nose, it should be remembered that not only must the lower protruding portion of the upper lateral cartilages be removed, but a hyperbolic wedge must be taken on either side, mesially, so as to blend with the newly created narrow bridge.

A direct blow on the nose may cause a depressed fracture of the cartilages with or without disturbance of the nasal bones. This must be recognized by clinical examination and *x*-ray. After correction, Simpson splints are helpful.

Septum. Most septums are deviated. This may be due to childhood trauma because the Negro with a naturally flatter nose and so less liable to reflected trauma, shows less septal deviation.

The crooked nose, the depressed bridge, the twisted tip is usually indicative of an accompanying deviated septum, which is probably secondary. The deviation is caused by a deflected ethmoid plate or a mal-alignment of the ethmoid and the vomer. Interestingly enough, a skull viewed posteriorly through the choana will virtually never show anything but a straight vomer bissecting the two sides, so that fractures of the vomer are always more anterior with a result that the cartilaginous septum twists or bends on the whim of these bones.

An accompanying submucous resection should not be done unless the septum is either causing blockage of breathing or preventing the ostia from draining.

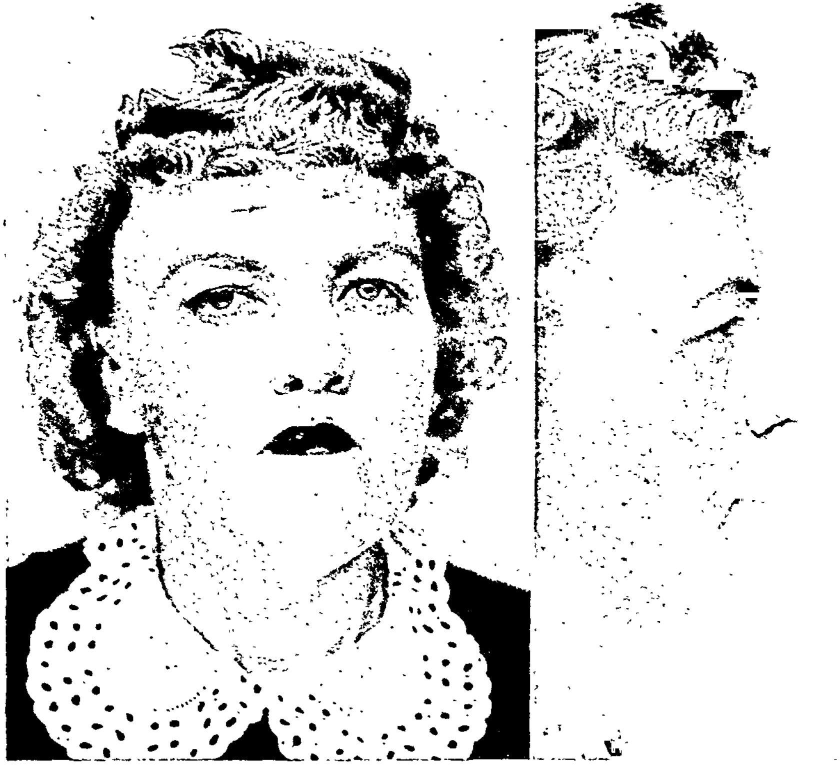


Fig. 13. Old hare-lip and nose presenting typical bad deformity of short tight lips with thin vermillion border, flattened nose on one side with disappearing columella, overhanging tip and markedly assymmetrical nostrils. A, cast taken before surgery from which pithwood models were made; B, C and D, before; E and F, after. The hump was removed with bayonet saws, the nasal process of the maxillary sawed through and fractured mesially to form a new bridge, the upper lateral cartilages trimmed and the tip completely reconstructed by undermining, and trimming the lower lateral cartilages. Rib cartilage was taken and a strut inserted over the bridge, another over the columella extending from the nasal spine to the tip. No external incisions were made over the nose. A curved, beveled piece of rib cartilage was inserted through the old lip scar and wedged under the nose over the entire lip.

If the cartilaginous portion of the septum is deflected to one side, attempt at correction may be made by either fracturing it, detaching it from its abnormal position and returning it to the vomer groove as suggested by Metzenbaum,[18] or following the technic of Brown,[4] and passing a wire through it, guarded by a lead plate and attaching the former to a biscuspid tooth for seven to ten days, by performing a thorough submucous resection and removing sufficient ethmoid plate and vomer posteriorly to break the spring, or adhering to Sheehan's[29] technic and incising the anterior portion of the septum after deflecting the mucous membrane. Often a combination of these technics is necessary, and even then they are sometimes unsuccessful.

Spurs on the septum may have to be removed prior to rhinoplasty in that the narrower nasal arch may impinge on them and cause obstruction.

Associated with a long nose is an overhanging septum and for its correction a wedge of the septum and mucous membrane is removed. (Fig. 5.) Oftimes the upper lip, immediately beneath the columella protrudes. For its correction, the nasal spine is removed with a sharp chisel.

Lower Lateral Cartilages. The lower lateral cartilages form the shape of the tip and with the aid of the septum hold the tip of the nose outward. Their contour fashions the size and shape of the nostrils. With the head tipped far backward, the triangle of the nose may be studied, and the cartilages on both sides compared.

A cleft tip which may be traumatic or congenital requires careful undermining beginning at the arch of the lower lateral cartilages and extending back along their mesial wing. After this is accomplished, a silk stitch is buried beneath the skin adhering the two wings of cartilage. Such a stitch should be taken in all cases and tends for a more shapely nasal tip.

The retrousse tip is corrected by taking a hocky stick portion of the lower lateral cartilage, wider at the handle, and the removal of a portion of septum along its anterior aspect. Often, the tip may appear retrousse because of a flattened bridge and may require the introduction of cartilage rather than surgery on the tip. The flattened tip may require a cartilage wedge placed through a columellar incision. (Fig. 7.)

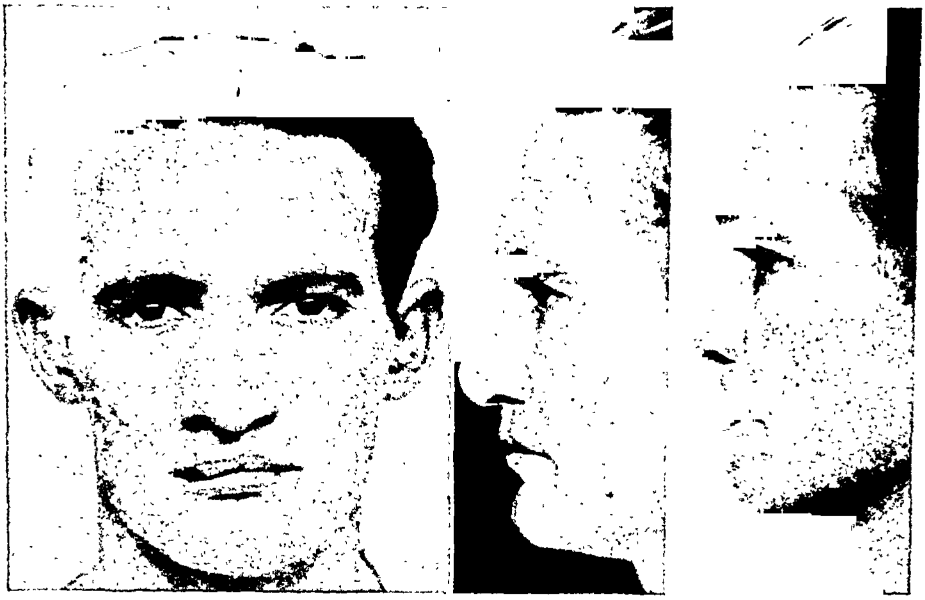

A B C

Fig. 14. Old hare-lip and nose deformity. A, before, showing depressed scar, assymmetrical lip longer on left side, with typical nasal deformity flattened on one side, narrowed vermillion border; B, before, retruded lip upper, nasal deformity with overhanging tip; C, after complete rhinoplasty with special attention given to tip reconstruction. The lip was narrowed and vermillion border adjusted by removing a complete wedge.

Columella. The character of the columella, be it long, short, narrow or wide, will affect the shape of the nostrils. Often an oblique columella will be straight when more lower lateral cartilage is removed from one side than another. A retracted columella may require the introduction of a cartilage strut through a small separate incision. A hanging columella may be corrected by removal of a portion of skin from both sides. Occasionally, surgery is required on the columella itself, such as a z-flap at the base for the correction of an abnormally oblique one or a V to Y incision at the base for one especially short.

The shape of the nostrils is dependent upon the lower lateral cartilages. In an abnormally flat nose with convex ala, it may sometimes be necessary to remove a full thickness section from the most lateral aspect of the ala and reattach it to the cheek. Sometimes, the wedge may be taken from within the nose, thus leaving no scar externally.

Base. In measurements taken of the base at the attachment of each ala, using casts taken from 200 female patients, the average was found to be $1\frac{1}{4}$ inches with the variance no more than $\frac{1}{16}$ inch. However, the construction of the patient's face, its wide or flat contour may often present an illusion that the base of the nose is wider than ordinary. Actual measurements should be taken by the surgeon, both for his own benefit in gauging the reconstruction and for the benefit of the patient.

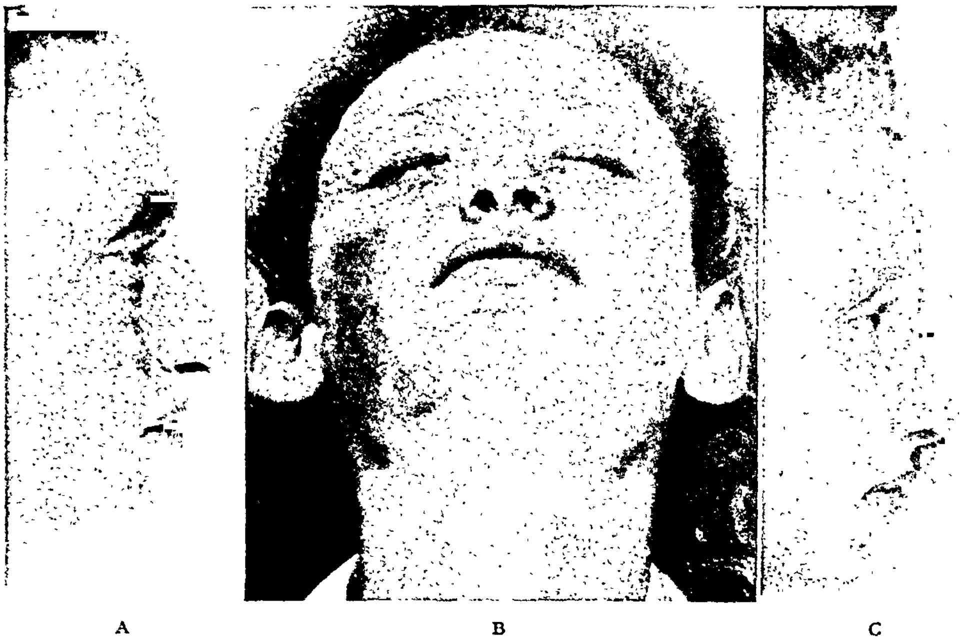


Fig. 15. Congenital deformity of the nose in a fourteen year old girl. This is about the minimum age at which a total rhinoplasty should be done. The psychic complexes often present make early surgery mandatory. A, before surgery; B, before; demonstrating the triangle of the nose formed by the base and laterally by the alar walls and bissected by the columella; C, after rhinoplasty.

Nostrils. The size of the nostrils is dependent upon the width of the columella, the base, the position of the septum and the shape of the lower lateral cartilages. Few noses present two equal sized nostrils. A septum deviated near its columellar portion will present itself near the median aspect of the nostril, causing the latter to be assymmetrical.

Where nostrils are abnormally assymmetrical, a portion of the medial wing of the larger may be bent toward the smaller, thus giving it more cartilaginous framework.

Straith,[33] Pierce and O'Connor[24] and others have discussed the technic of handling atresia of the nostrils. We use a thin split skin graft placed around dental stent and inserted in the nostril. (Fig. 16.)

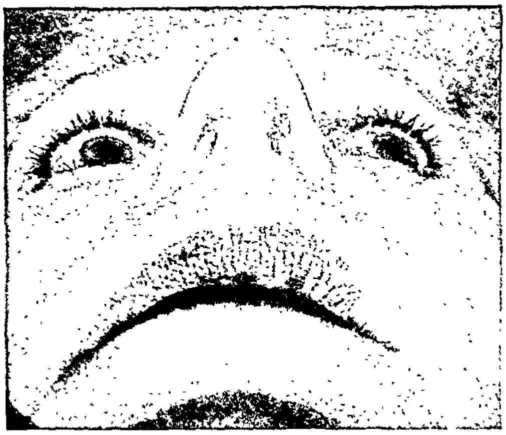


Fig. 16. Paraffinoma resulting in complete nasal atresia. Split skin grafts on dental stent were inserted in each nostril to form a new lining.

OPERATIVE PROCEDURE

Preoperative Treatment. The patient enters the hospital the preceding night and is given a full dose of barbiturate. The following morning, two hours before surgery, a similar dose is given. One hour before surgery, morphine gr. $\frac{1}{4}$ and scopolamine gr. $\frac{1}{150}$ is administered by hypodermic. These preoperative measures not only serve to prepare the patient fully following a good night's sleep, but also act as a physiological prophylactic against novocaine or cocaine toxicity. When general anesthesia is used, appropriate preoperative measures are taken.

Anesthesia. Except in occasional cases, local anesthesia is used exclusively. One half hour before surgery, applicators saturated with cocaine 10 per cent are applied to the region of both sphenopalatine foramen near the posterior aspect of the attachment of the middle turbinate. Following this, both sides of the nose are carefully packed with cocaine 10 per cent to anesthetize the branches of the sphenopalatine ganglion supplying the mucous membrane of the nose. These packs are allowed to remain and are removed at surgery.

After the face has been thoroughly washed and the vibrissae clipped and a suitable, mild antiseptic applied in and

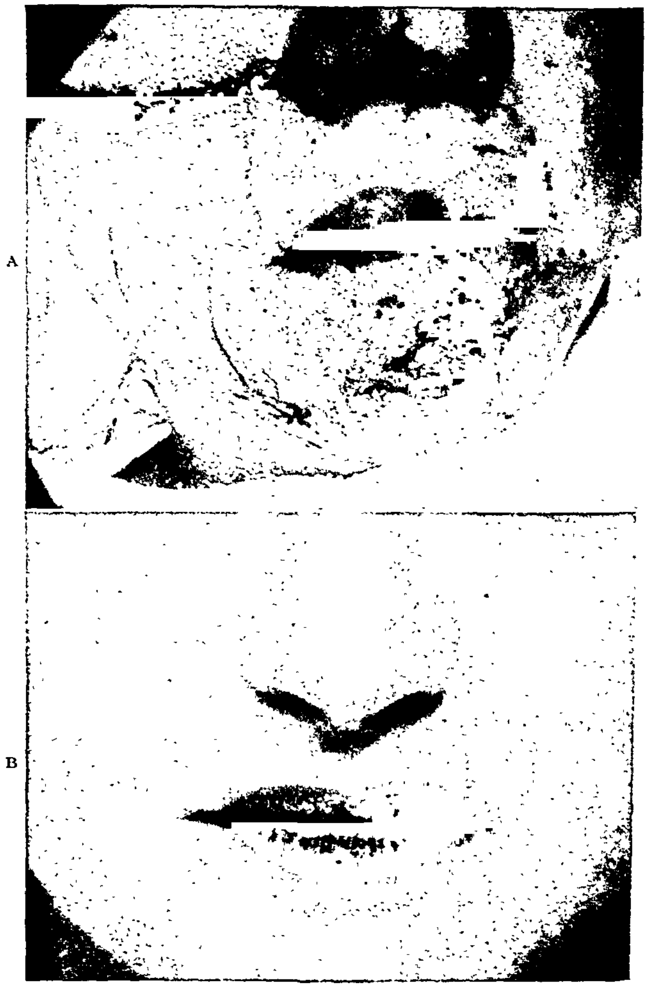


Fig. 17. Scars over the nose and face. A, before; meticulous cleansing of the tissue is primary; B, after; the subcutaneous tissue is approximated with No. 000 white silk; the skin sewn with No. 000 to No. 000000 black silk. Following early removal of stitches, adhesive bridges are used to maintain tension.

around the nostrils, the patient is carefully draped. The eyes and mouth are covered with damp gauze.

A short ribbon retractor lifts the nostrils, exposing a fold between the upper and lower lateral cartilage. Novocaine 2 per cent with 15 drops of adrenalin to the ounce is injected in this area on either side, thoroughly undermining the tissues over the nose. The solution is further infiltrated, blocking off the nerve endings of the supratrochlear, infratrochlear and infra-orbital nerves. The columella is anesthetized and injections are made into the nasopalatine nerve on both sides as it dips into Scarpa's foramen.

Later, injections are made along the lower lateral cartilages which gently balloon the tissues away allowing for more thorough clean dissection.

In all, 15 to 25 cc. of novocaine is used and the anesthetic is gently massaged into the tissues so that it will act as a more efficacious anesthetic and hemostatic agent. Following this, a one inch "nu gauze" packing is used in the nostrils to prevent any bleeding into the throat.

Operative Procedure. A short retractor lifts the nostril and using a No. 11 Bard Parker blade, an incision is made between the upper and lower lateral cartilages, brought forward and slightly downward, joined with the opposite incision and carried down between the septum and columella. Using a curved Mayo scissors, the skin over the nose is thoroughly undermined leaving as thick a flap as possible.

An incision is made through the periosteum on either side over the bridge and the former is reflected medially. The hump is removed with right and left bayonet saws and smoothed with a fine rasp. Moist applicators are used to wipe out any bone fragments or dust.

The upper lateral cartilages are severed from their medial septal attachment and the excess trimmed. The anterior aspect of the septum is shaved down to the desired proportion.

Through a separate incision in the lateral aspect of the nasal vestibule, angle periosteal elevators are first introduced, followed by bayonet angle saws and the nasal process of the maxillary bone is sawed through on both sides. With a piece of gauze over the bridge and the aid of gentle, steady pressure, the distal fragments are fractured toward the mid-line forming a new bridge.

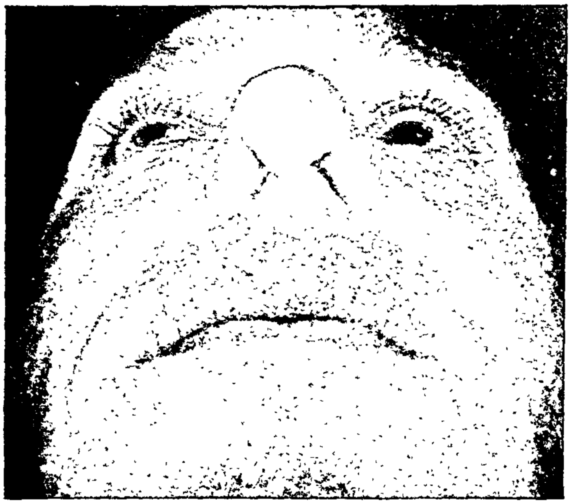


Fig. 18. Paraffinoma of ten years' standing. Showing the gravitation of the paraffin to the dependent portion and the resulting fibrotic reaction. The tip of the nose was undermined and an attempt was made to remove the granulomatous material and fibrous tissue. Histological picture presents multinucleated giant cells and on occasion the area may become neoplastic. The skin over the center of the nose was reflected down to form the new tip and a forehead flap was brought down to cover the defect.

Through incisions along the lower aspect of the lower lateral cartilage, the latter are dissected free (Fig. 4) and the required amount of cartilage is removed without disturbing the nasal lining. Where required, a wedge of septum is removed from its inferior aspect.

A tension suture of No. 1 silk approximates the columella and septum, while the mucocutaneous incision is sewn with No. 000 silk. The nostrils are packed lightly with vaseline gauze.

Various postoperative splints are applied: the dental stent as recommended by Aufricht[1] and the metal splints as used by Brown.[4] As a rule we use adhesive alone

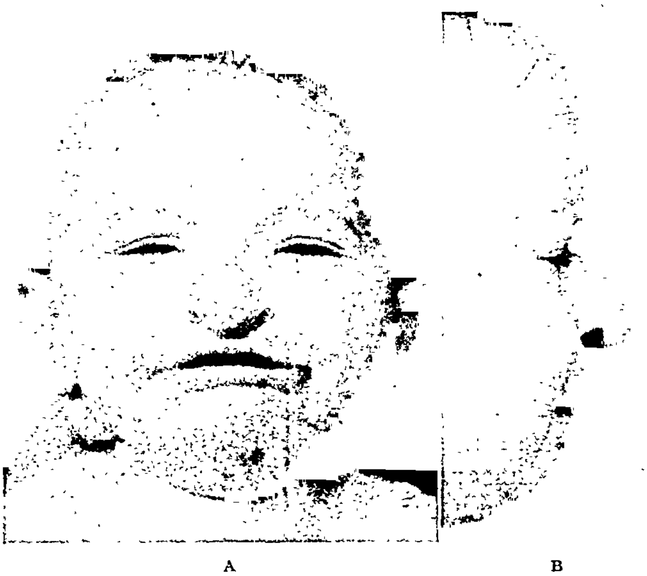


Fig. 19. Angioma of the nose which was treated both surgically and with radium; A and B before surgery.

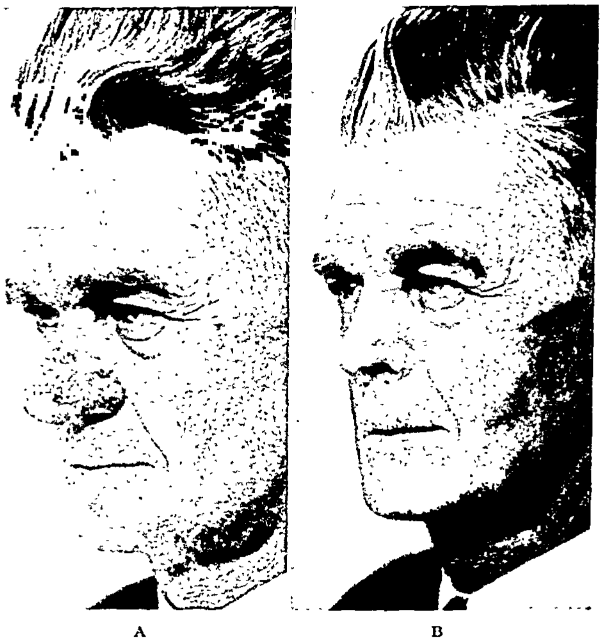


Fig. 20. Rhinophyma of the nose of thirty years' duration. Treated surgically with an incision from ala to ala, one-fourth inch from the alar margin. The skin flap over the nose was raised, the underlying tissue dissected away down to the cartilage. A section of skin was taken off the flap and then the latter was sewn in place with black silk. Suberythema doses of x-ray were used after surgery.

over the bridge and ala with satisfactory results.

Postoperative Treatment. Iced cloths are applied over the glabella and eyes and these are continued for several days. The patient is advised to open and close the eyes frequently which aids in eliminating the edema. The initial dressings and packs are removed in twenty-four hours. At this time, the nose is thoroughly cleansed, the mucous membrane shrunk with a suitable solution, vaseline is placed over the stitched areas, and adhesive reapplied to the bridge and tip. If a metal splint has been used, it is reapplied for another twenty-four hours.

FRACTURES OF THE NOSE

Recent. Straith and De Kleine,[34] Safian and Tamerin[27] have emphasized the importance of early diagnosis and treatment. Within the first week, but preferably within the first few hours, fractures are considered recent. Those without deformity or displacement are treated conservatively. The diagnosis is made both clinically and with the aid of *x*-ray (an ordinary dental film taken in the lateral view usually being the most helpful).

The signs and symptoms of fracture are epistaxis, swelling, intranasal blockage, crepitus, pain and deformity. Thorough shrinking and cleansing of the nose will make for a more accurate diagnosis.

After suitable anesthesia a medium sized needle holder protected by rubber tubing is inserted through the nostril, upward and anterior; using gentle, steady pressure with the instrument the fractured bones may be replaced to their normal position. An Ash forceps is used when the fracture has occurred through the nasal process of the maxillary bone. Adhesive may be used as a postoperative brace.

Septal depressions, fractures of the upper lateral cartilage and displaced compound fractures of the bones may prevent restoration of the nose to its previous shape and later rhinoplastic correction may be necessary. Should the septum be displaced, Metzenbaum's technic[18] may be employed.

Old. Old fractures are reconstructive problems. Not only must the bones of the bridge be reformed but so, too, must the upper lateral cartilages, the septum and the tip. Unless rhinoplastic procedures are carried out, the result will leave both the doctor and the patient unhappy.

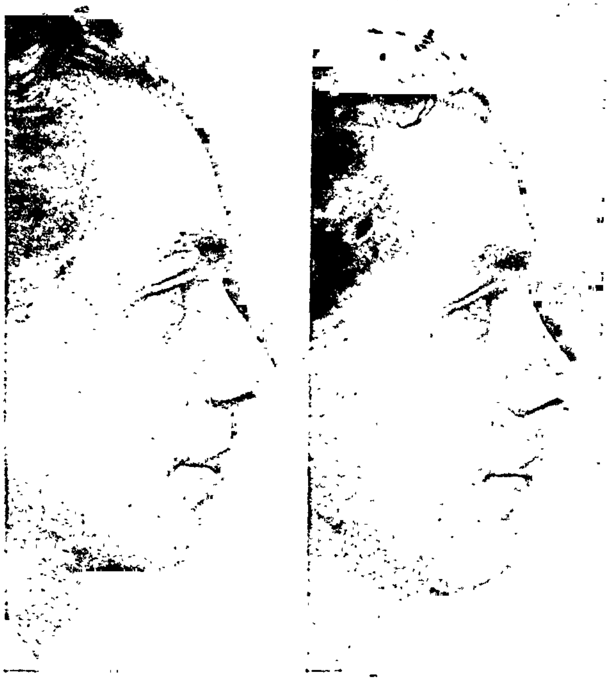


Fig. 21. Congenital deformity of the nose in conjunction with retrusion of the chin. A, before; B, after rhinoplasty followed later by insertion of curved molded section of rib cartilage in chin and sewn to periosteum, thus building out chin and giving desired symmetry to face.

SADDLE NOSE

We shall consider all depressions requiring the addition of cartilage or bone in this category.

Autogenous cartilage, advocated by Brown[5] and Peer,[23] or preserved cartilage suggested by Pierce and O'Connor[24] may be used. The former may be taken from the costal rib margin, from an ear or from the nose itself. The latter is stored in the ice box in a merthiolate-saline solution, 1:4. In both the perichondrium should be removed.

If the depression is small, a suitable piece of cartilage may be laid on the anterior aspect of the septum through an intranasal incision. If a larger depression is to be filled, it is necessary to maintain a supportive strut between the tip and the nasal spine. (Fig. 6.) It is best that a single piece of cartilage be so cut, bent and beveled that it runs from the glabella to the tip of the nasal spine. New and Erich[21] have been treating such cartilage to prevent its curling or warping.

Some deformities are such that they require the cartilaginous strut to be inserted through a columellar split incision. (Fig. 7.) After the mucous membrane is dissected away from the more spacious side of the septum, a wedge of cartilage is inserted. The use of a rounded rectangular piece of cartilage has several advantages: It may be thinned more without losing its strength and there is less tendency for the cartilage to curl. Care should be taken to thin that inferior portion resting on the columella to prevent the latter from being too wide.

Should the occasion arise, it might be necessary to use bone to fill the depression. Products foreign to the body such as ivory, plastics, metals, paraffin, etc., are to be condemned.

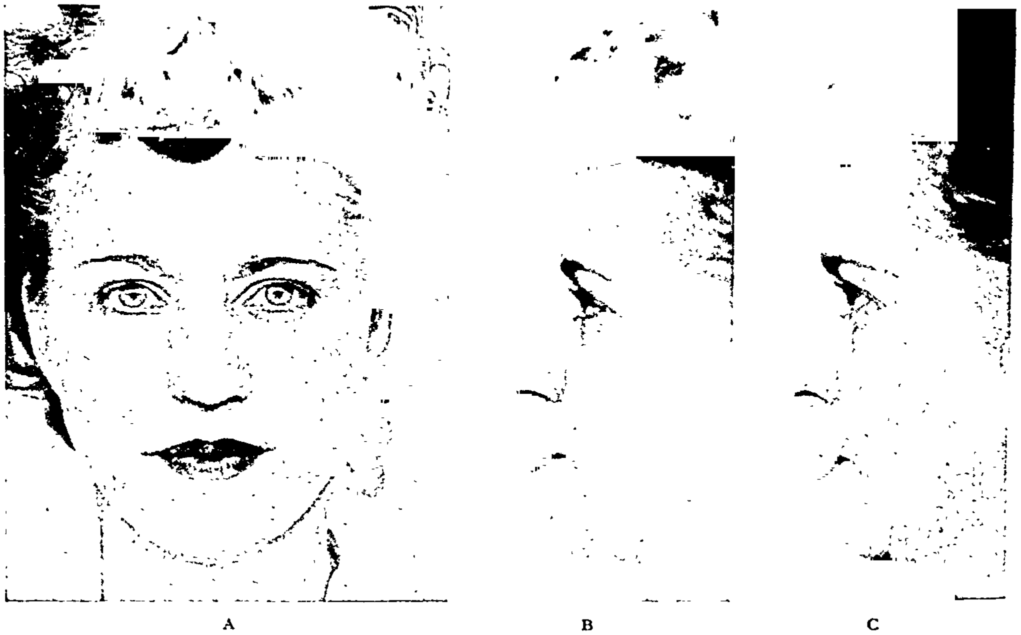


FIG. 22. Old fracture of nose in conjunction with congenital deformity demonstrating nasal hump, a central depression, protruding tip and a disappearing columella. A and B, before surgery; C, after reconstruction.

HARE-LIP NOSE

Old hare-lip noses should be repaired with the aid of rhinoplasty. External incisions are unnecessary and the work should be done within the nose. Brown and McDowell[6] rightfully stress the importance of considering the nose as a whole and when necessary removing lower lateral cartilage from the opposite side to make it conform with the affected side. Cinelli[9] often uses this removed cartilage and inserts it into the affected side.

Wherever possible the patient should be allowed a few years after adolescence before a complete corrective procedure is attempted. However, rather than allow a child to attain a reasonable age carrying a physical stigma, interference is often resorted to before the child reaches maturity. In these cases, sufficient surgery should be done to allow for a reasonable cosmetic improvement without interfering too much with the cartilage or the nasal framework keeping in mind that a more thorough reconstruction will be done at a later date. (Fig. 12.)

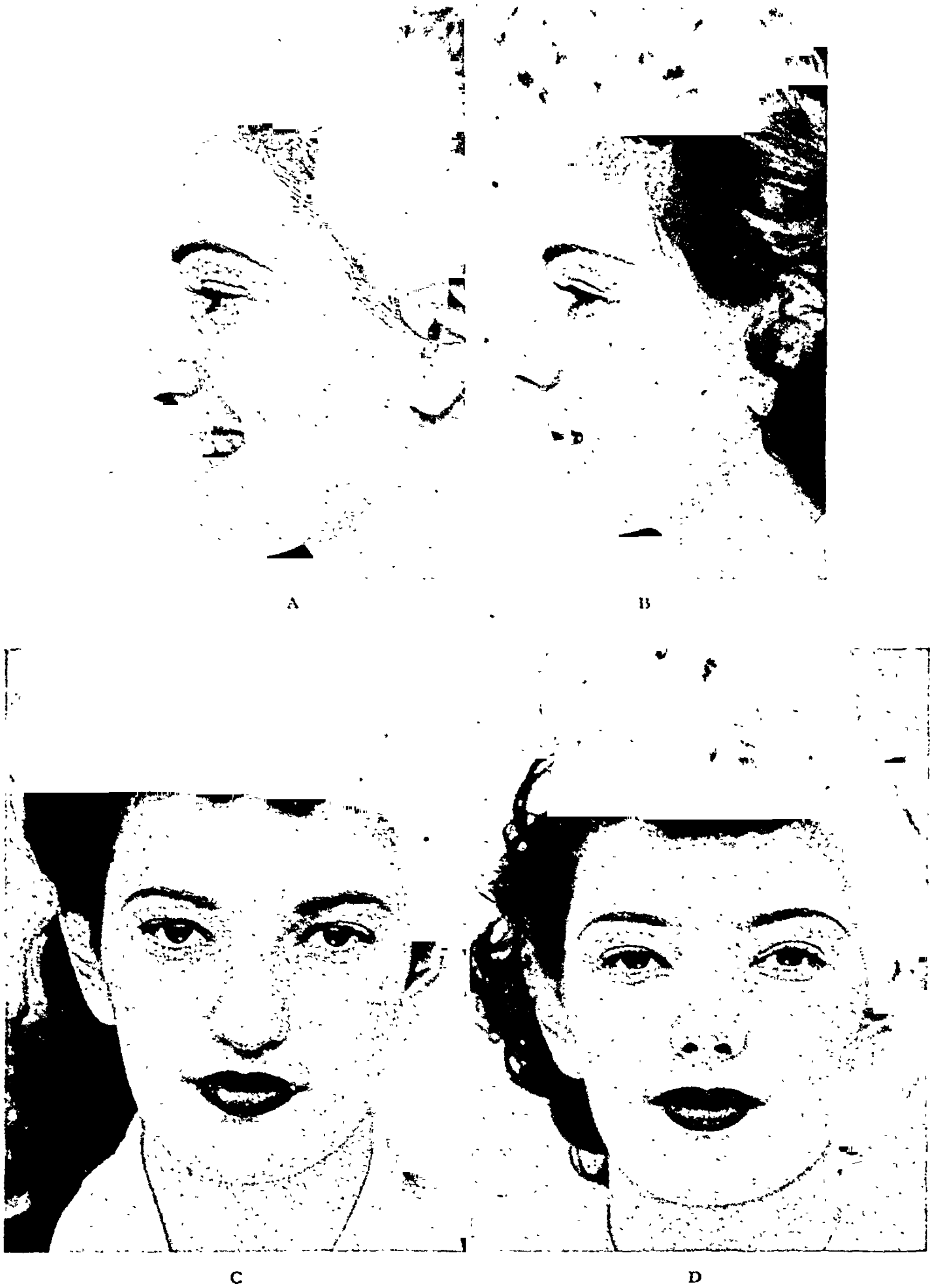

A B C D

Fig. 23. Old fracture of the nose with a dislocated septum. A and C, before; demonstrating the broad flattened dorsum, dropped tip and disappearing columella; B and D, after reconstruction; it was also necessary to relocate the septum into the vomer groove.

Many of the defects seen in secondary hare-lips might be avoided at the initial operation. Repairing the lip itself secondarily is usually not too difficult; the nose as a rule is the problem. Therefore, more time should be taken at the initial surgery in repairing the latter. We make a practice of thoroughly undermining the lower lateral cartilages both anteriorly and posteriorly so that when the point of the ala is turned inward and over-corrected in its angle to the columella, the cartilage will slide to its new position and is easily held in place with silk mattress sutures. A crescent of lining in the vestibule may be removed on the affected side to eradicate the flare often present following the repair of a hare-lip.

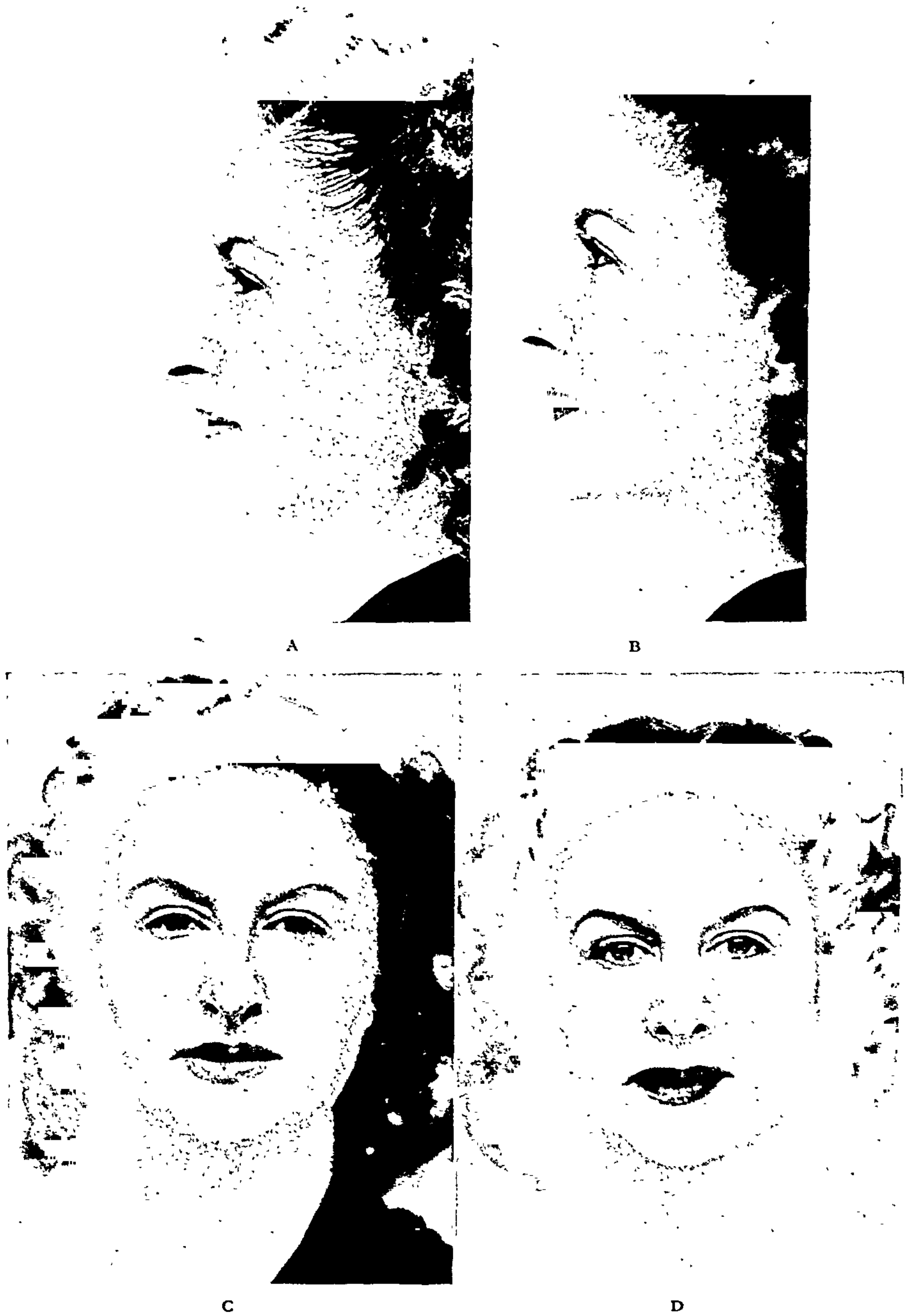


Fig. 24. Old fracture of the nose with a dislocated septum. A and C, depicting the associated congenital deformity, namely, the nasal hump and the long anterior posterior tip dimensions; B and D, after surgery; relocation of the septum into the vomer groove and reconstruction of the nose to the required dimensions.

When repairing an old hare-lip nose we remove a hockey stick of lower lateral cartilage from the unaffected side, while on the affected side, the lower lateral cartilage is severed at the arch, the lateral wing is undermined and no cartilage is removed which allows the nostril to assume larger proportions. Much of the deformity may be laid at the doorstep of the upper lateral cartilage because on the affected side it has flattened out and lost its natural curve, whereas on the opposite side the angle of the curve is usually over-acute. Usually there is a disappearing columella especially where it joins the philtrum and a cartilage strut is necessary. (Figs. 12, 13 and 14.)

TUMORS OF THE NOSE

Classification:

- Benign:
  1. Papilloma
  2. Adenoma
- Connective Tissue:
  1. Fibroma
  2. Chondroma
  3. Osteoma
  4. Myoma
  5. Myxoma
  6. Osteochondroma
  7. Angioma
     - a. Hemangioma
     - b. Lymphangioma
- Malignant:
  1. Epithelial
     - a. Carcinoma
       - (1) Squamous cell carcinoma
       - (2) Basal cell carcinoma (Rodent ulcer)
       - (3) Transition cell carcinoma (Grade 4)
       - (4) Columnar cell carcinoma
     - b. Adenocarcinoma
  2. Connective tissue
     - a. Sarcoma
       - (1) Fibrosarcoma
       - (2) Osteosarcoma
  3. Miscellaneous
     - a. Hodgkins
     - b. Lymphosarcoma

Benign. Papillomas are said to arise from the papillae of the basement membrane, and usually occur where there is squamous cell epithelium. The infantile type which may or may not be caused by a filtrable virus, recur easily, may be transplanted and their excision or cauterization should be done with this in mind. The adult type usually responds to the snare.

Adenomas are rare and occasionally occur in the nose and pathologically may or may not have ducts. The growth should be excised.

Fibromas occurring in the nose may be distinguished from polyps being redder and do not have the bluish, translucent appearance, but are difficult to distinguish clinically from sarcomas. They may bleed very easily when excised.

Chondromas are rare and microscopically present a picture of normal appearing cartilage in an abnormal position.

Osteomas usually arise from the nasal bones, are painless and may cause pressure symptoms and cosmetic deformity. Microscopically, they present a picture of distorted Haversian systems and absent marrow. These and chondromas are easily excised and do not recur.

Angiomas are not uncommonly seen in Hesselbach's triangle and on the tip of the nose. They usually react favorably to radium. (Fig. 19.)

Malignant. Squamous cell carcinomas may be differentiated by the Broder classification. The amount of cell mitosis present the degree of cell differentiation, the amount of fibrous tissue around the tumor, the presence of pearls in the cellular structure, all serve to judge the tumor. Though the degree of malignancy in this classification definitely affects its operability, the reaction to radiation therapy is highly variable and does not depend upon the classification.

Basal cell carcinoma behaves like benign tumors and usually invades by direct extension without metastasis. Incidentally the tumor apparently does not arise from the basal cells because microscopic sections show no relationship. The growth should be thoroughly excised with the scalpel or cautery.

Transition cell carcinomas may occur in the sinuses and extend into the nose.

Though they present lymphatic cells on microscopic examination in association with the epithelial cells, the former are probably normal cells in a carcinomatous area.

The growths are usually extensively malignant by the time diagnosis is made and the treatment, therefore, is radiation because the tumor has usually metastasized extensively.

Fibrosarcomas, occasionally found in the middle turbinate, bleed easily, present a beefy red appearance and because the blood supply contains no endothelial cells, a major hemorrhage may occur. It responds readily to radiation.

Osteosarcomas arising from the bony structures are rare in the nose.

Endotheliomas arising from the meninges may hang down into the nasal vault. They metastasize late and by the blood stream.

Blair, Moore and Byars[3] have classically described malignant lesions, their diagnosis, treatment and the reconstructive method. A time period should be allowed to elapse between the removal of all malignant growths and reconstructive surgery. Too often one sees recurrence after a lengthy piece of surgery. Though excision or cauterization of malignant tumors should be radical, the hand should be guided by the thought of future cosmetic improvement by plastic procedures.

TOTAL RESTORATION OF THE NOSE

Blair[2] has aptly stated that a surgically reconstructed nose must be covered with smooth skin, have a normal contour, have epithelial lining and provide an adequate airway. There are many methods of transferring a raised pedicle or tubed flap, and each asks for meticulous planning and judgment. One may use a forehead flap, a clavicular tubed pedicle taken directly or waltzed to the nose, a tubed pedicle from the body transferred to the wrist, or from along the neck extending from the mastoid process to the clavicle. All of these methods have been discussed by Blair,[2] Gillies,[12] Ivy,[14] New,[20] Smith,[31] Maltz[17] and others.

The original method of Nelaton and Obre'danne[19] used in modification by the above authors in conjunction with a forehead flap is most appropriate for the formation of the lining, of the ala and of the columella. After careful measurements, a flap on the forehead is raised and a split skin graft is sewed to the apposing side, raw surface approximating raw surface at a sufficient distance from the end to form lining for the bridge of the nose. Another thick split skin graft, cut with Padgett's dermatome,[22] is sewed on the forehead to cover that area from which the flap is later to be taken. The entire flap is then sewed back in place and in a period of three or four weeks again elevated. The distal end is now thinned and turned on itself to form a lining for the lower portion of the reconstructed nose. The deformed nose having been carefully dissected so as to leave a raw bed, the pedicle is turned downward and meticulously sewed in place.

In three to four weeks, the pedicle is detached, leaving the required amount of tissue on the nasal defect and the remainder is returned to the forehead to cover the previously created defect. The excess tissue on the nose may be trimmed after the induration has subsided. To create nasal framework, autogenous rib cartilage, necrocartilage (Lamont), or bone may be appropriately modeled and inserted beneath the tissues to form an anterior bridge. Sulfanilamide crystals are sprinkled on all cartilage grafts before they are implanted.

The most important principles to be remembered are to retain the integrity of the circulation of the pedicle during its transfer; trauma or excessive handling and twisting will cause thrombi and hematoma and the pedicle may be lost. Care should be taken in the measurement before surgery, so that one is not embarrassed by lack of tissue and sufficient pedicle should be allowed for shrinkage. One is always in a dilemma when thinning out the tip before doubling on itself. If made too thin, the circulation may be lost along with the tissues, and if made too thick it is cosmetically unsightly.

SUBTOTAL RECONSTRUCTION OF THE NOSE AND THE NASAL TIP

Surgery about the nasal tip and partial reconstruction of the nose are more common than total restoration. Kazanjian,[16] Straatsma,[32] Straith,[33] Smith[30] and others have presented cases covering the problems confronting the plastic surgeon. Gillies[12] carefully reviewed the conditions in which tube flaps are preferable to free skin and outlined the common donor sites for tubed pedicle flaps, the operative technic and the plan to be followed. More leeway is possible in partial restoration than in total; however, if the defect is large, the forehead is still the site of choice from which the pedicle is taken.

The technic is similar to that previously described except that the split skin graft is approximated on the end of the pedicle because the latter is not doubled on itself to form the tip. (Fig. 10.)

For reconstruction of defects on the tip itself, the surgeon has a wide choice of methods. He may transfer a pedicle from the body, use a forehead flap, or a pedicle from the side of the face, or a pedicle may be turned from the upper part of the nose onto the defect, or skin from both sides or one side of the face be readjusted. (Fig. 9.) Recently a case presented itself with a large defect in both ala. (Fig. 11.) Because the patient had a reasonably large nasal skeleton, a new technic was used. Incisions were made immediately below the upper lateral cartilages, carried forward, joined, and the columella severed from the inferior portion of the septum. The nose was then cut down by the technic described in the section on congenital deformities. Following this, an incision was made over the glabella through an old scar, carried downward on the left side, and then with time consuming care, the skin over the nose was dissected away from the lining. The columella was cut loose near the tip and a small portion removed. The skin over the nose was rolled downward and the columella sewed in place. A full thickness graft was taken from behind the left ear and sewed over the defect left on the bridge of the nose. Though over bone and in a potentially infected area, the graft took 100 per cent and the patient had a reasonably presentable nose in one stage.

Bulbulian[8] and others have accomplished much in the field of prosthetic appliances. The latter are both practical and necessary in certain cases. Regardless of what method is used, careful preoperative thought and surgical judgment are presupposed adjuncts.

PARAFFINOMA

Paraffin was used several hundred years ago to aid impotent men maintain their self respect. At the turn of the century it was again introduced for cosmetic purposes. The cheeks, nose, eyelids, neck and forehead were the usual hunting grounds. As a rule, signs of trouble do not appear for some time after injection. Then it gravitates away from the area of introduction and begins to act as a foreign body creating fibrosis and induration, and sometimes the tissue breaks down to necrosis. (Figs. 16 and 18.) Microscopically, they present a granulomatous picture and aside from the fibrous cell infiltration show many giant and plasma cells.

The removal of paraffin is not easy and if present in any amount, must be done in several stages. Because of the fibrosis, cavities may remain with hard walls that will not collapse and fill in; this must be kept in mind and adjacent areolar tissue utilized during operation. The skin over the paraffinoma must be taken out in a section in order to restore the contour. The wounds do not heal easily and often will present a serous drainage until such time as all of the deeper paraffin is removed.

If a large deformity is left or in the presence of skin destruction due to necrosis, a flap or pedicle may be utilized. The surgeon should always caution a paraffinomatous patient to reserve optimism.

RHINOPHYMA

This is an idiopathic inflammatory disease, overwhelmingly more common in men, and characterized by an early dilatation of the blood vessels. Later there is an invasion of connective tissue affecting sebaceous glands, the underlying fat and the skin. The cosmetic deformity makes it easily recognizable and as it slowly develops over a period of years, the lobulated masses secreting sebaceous substances become more prominent.

In mild cases, shaving the mass with a razor and allowing the undersurface to granulate and epithelialize will help the condition. In exacerbated cases, complete dissection of the mass is necessary and the area may be covered with a skin flap from the bridge of the nose. (Fig. 20.)

SCARS AND KELOIDS

When removing a scar on the nose, the skin should be thoroughly undermined on either side twice the width of the area removed. Either white No. 000 silk or catgut is used to approximate the subcutaneous tissue and No. 000 black silk is used to approximate the edges. In longer scars, two or three mattress sutures should be taken so as to hold the edges everted. In areas of relaxed tissue such as the neck, dental rolls held in place by silk tied over them, are used for pressure. Updegraff[37] has emphasized the importance of adhesive tape bridges postoperatively to prevent spreading of the incision.

Where keloids are expected, suberythema doses of x-ray or radium should be used postoperatively. When removing keloids, the roentgen ray may be used as an adjunct to the scalpel. Large keloids may occur regardless and the patient should be so informed.

CONCLUSION

Reconstructive surgery of the nose, aside from the presupposed knowledge of anatomy and physiology, demands careful planning, judgment and patience at the operating table. Gentleness in handling tissue cannot be overstressed, speed is to be condemned and the operative eye must always be focused toward the future cosmetic result.

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MANY minor operations in the mouth can be performed under local anaesthesia, but if the operation is expected to occupy some length of time and bleeding to be free it is wiser to give a general anaesthetic, preferably with the introduction of an intratracheal catheter.

NON-TUBERCULOUS LUNG ABSCESSES

SURVEY OF FOUR HUNDRED SEVENTEEN CASES

VINCENT D'INGIANNI, M.D.
[illegible]
NEW ORLEANS, LOUISIANA

BETWEEN the years of [illegible] to [illegible] there were 437 admissions with diagnosis of lung abscesses at Charity Hospital of Louisiana in New Orleans. Of these, 113 were readmitted. This group was composed of 268 (61.4 per cent) white patients, and 169 (38.6 per cent) negro patients. The majority of patients were admitted between the thirty to fifty year group in both races. Death rate was greater at the extremes of the age groups and proportionately less in the thirty to fifty year group. Of the 437 patients admitted, only 417 charts were complete enough to use in the following statistical study.

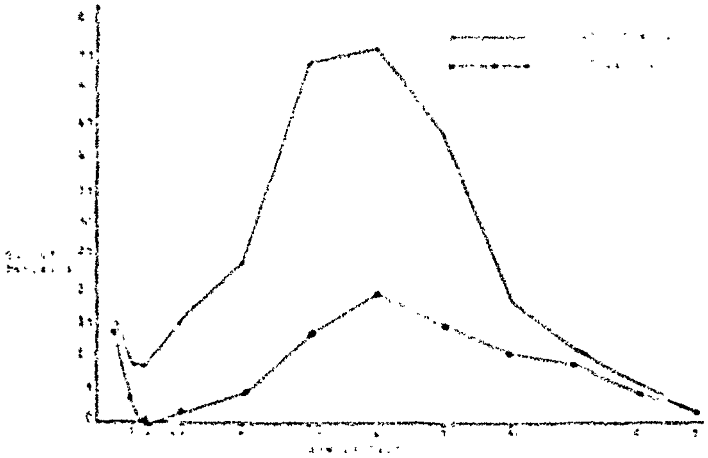

Fig. 1. Mortality [illegible]

This series deals with the status of patients on their discharge from the hospital. Some who were thought to be cured may have had recurrences, and some who were improved may have progressed until cured. Of these, there were twelve (2.8 per cent) cured, 124 (29.8 per cent) improved, and seventy-six (18.4 per cent) unimproved.

No marked discrepancy was found between male and female of both white or colored races, excepting the occurrence of frequency in the male, the ratio being two males for every female with the disease comparing white and negro patients, which was not only found constant in this study but also in many other statistical studies. Of the total admissions 273 (67.2 per cent) were males. This is in keeping with the following reports:

Author	No. Cases	Males No. Per Cent
Reves	60	40 (66.6)
Fisher	88	58 (66.0)
Jackson	124	83 (65.5)
Neuhof	45	29 (64.5)
Kline	55	38 (69.1)
Lueth	101	87 (86.0)
Cutler	90	61 (67.8)
Allen	100	81 (81.0)
Gray	41	28 (68.2)

There were 205 (49.2 per cent) deaths, as illustrated in Table 1, with appreciable difference between racial mortality, white 39.6 per cent, negro 60.0 per cent. Lueth found 44.4 per cent mortality rate in the negro group versus 38.6 per cent in the white group. Reves found a mortality rate of 37 per cent in white patients and 50 per cent in negro patients.

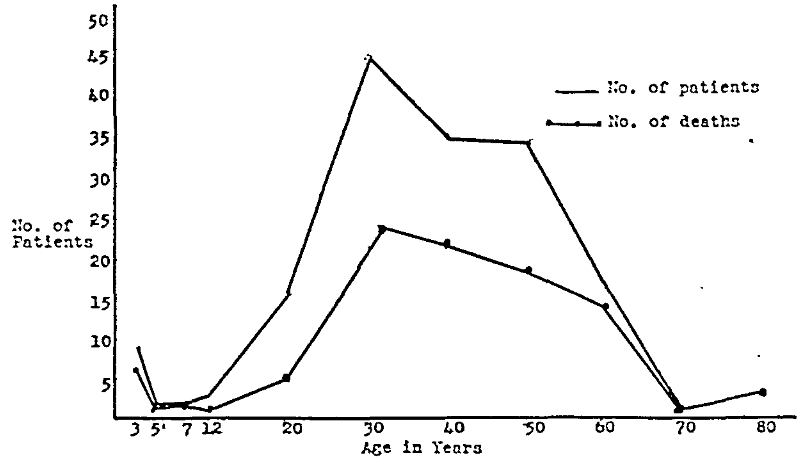

Fig. 2. Mortality and admissions in age group of colored patients.

Of the 205 deaths, 159 (78.9 per cent) had postmortem examinations, seventy-seven were white and eighty-two were negroes. Many of the patients admitted did not live long enough for a diagnosis, and there were also some that remained in the hospital as long as sixty days without a correct diagnosis, this being established at autopsy. Twenty-seven (6.5 per cent) were demonstrated to have had lung abscesses which were overlooked by the clinician.

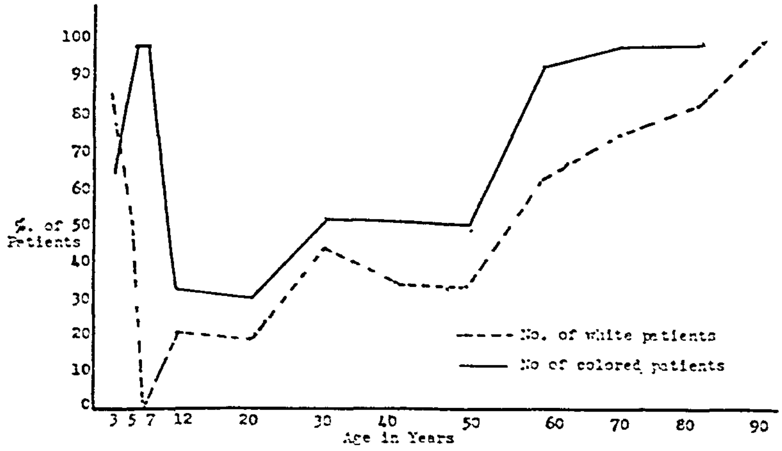

Fig. 3. Contrast of mortality in age group of white and colored patients.

In the twenty to forty year group admitted to the hospital 60.7 per cent were white patients and 67.1 per cent were negro patients. Kline reports that 63.8 per cent of his patients belong to the second and fourth decade. It becomes apparent that the mortality rate is inversely related to the age group when one considers that the majority of admissions and the minority of deaths occurred in the twenty to forty age group, The mortality rate was 41.6 per cent for the twenty to forty age group and 57.1 per cent for the rest of the age groups.

By referring to Figure 3, it will be noted that the negro mortality rate was higher in each group except the first. One possible explanation, since the period of time elapsing between the onset of the disease and admission is about the same, as shown in Table II, is that the negro is less resistant to infection of the lungs.

These patients were admitted to the services of ninety physicians and surgeons. Some of the surgeons were gynecologists, urologists and obstetricians. A few patients were admitted to the Dermatology Ward.

Table III contains the results obtained by those doctors who attended five or more patients. The number on the left of the table replaces the doctor's name. The mortality rates in respect to individual physicians and staffs vary between 20 and 60 per cent with the exception of one who had no deaths.

TABLE I

OUTCOME OF PATIENTS ADMITTED TO HOSPITAL

	C	I	U	D	Total
White					
Male	7 (3.91%)	55 (30.6%)	39 (21.8%)	78 (43.5%)	179
Female	2 (2.71%)	30 (40.5%)	16 (21.6%)	26 (35.1%)	74 253
Colored					
Male	2 (1.75%)	27 (23.7%)	14 (12.2%)	71 (62.3%)	114
Female	1 (2.0%)	12 (24.0%)	7 (14.0%)	30 (60.0%)	50 164
	12	124	76	205	417

C—cured.
I—improved.
U—unimproved.
D—died.

TABLE II

DAYS SPENT IN HOSPITAL IN RELATION TO DURATION OF ILLNESS PRIOR TO HOSPITALIZATION

No. of Months	White		Colored	
	Male, Per Cent	Female, Per Cent	Male, Per Cent	Female, Per Cent
1	25.4	32.5	25.7	20.8
2	33.6	29.1	32.1	21.4
3	17.6	9.5	71.4	5
4	43.5	1	19	0
5	24.8	26	24.5	93
6	25	26.6	28.5	50
7	0	34.5	45.5	0
8	14.2	5	46	0
9	20	8	36	0
10	66.1	82.5	4	0

The etiological factors contributing toward the formation of lung abscesses in 129 of the cases can be found in Table IV. From Table V one can conclude that there is an agreement in the causative factors but a disagreement in the order of their frequency. Reyes found that the etiological factor in production of lung abscesses was pneumonia in 61.8 per cent and tonsillectomy in 21.8 per cent. Jackson found the etiology to be upper respiratory infection in 37 per cent, tonsillectomy in 29 per cent, and other surgery in 10.5 per cent. Morrison reported 39 per cent having preceding tonsillectomy and 13 per cent having other preceding surgery. Cutler found that 54 per cent had preceding surgery and 28 per cent had pneumonia. Sweet found 56 per cent followed upper respiratory surgery, 11.2 per cent followed other surgery, and 15 per cent followed pneumonia.

The causes of lung abscesses in 12.4 per cent of the white patients and 12.8 per cent of the negro patients at Charity Hospital can be found in previous surgery. This is not in agreement with the investigations of Jackson who reported 22 per cent following surgery, Morrison 52 per cent, and Cutler 54 per cent. However, it will be noted that the prognosis seems to be better for those cases caused by previous surgery than those caused by other factors, as the mortality rate for the previous surgery group is 35 per cent, whereas the mortality rate for the other groups is 55 per cent, a difference of 20 per cent. A more detailed study of surgery as an etiological factor is set forth in Table vi, where it is shown that there were a greater number of white female patients than male patients and a greater number of negro males than females susceptible to lung abscesses following these procedures.

Table III
RESULTS OBTAINED BY PHYSICIANS

Doctor	Total	C, Per Cent	I, Per Cent	U, Per Cent	D, Per Cent
Medical					
2	14	0.0	7.2	28.7	64.1
3	30	6.6	50.0	23.4	20.0
4	27	3.7	37.1	18.4	37.1
5	27	11.1	14.8	25.9	48.2
8	15	0.0	20.0	60.0	20.0
15	13	0.0	46.2	7.7	46.2
16	44	2.78	34.1	40.8	45.4
18	12	8.3	25.0	41.6	25.0
19	8	0.0	50.0	25.0	25.0
20	19	0.0	5.2	31.5	52.6
22	5	0.0	40.0	40.0	20.0
23	7	0.0	42.8	0.0	57.2
28	29	3.4	48.2	17.5	31.0
34	20	5.0	25.0	10.0	60.0
38	6	0.0	16.7	50.0	33.3
53	8	0.0	25.0	37.5	37.5
75	6	0.0	33.3	66.7	0.0
Surgeons					
26	28	3.5	17.7	47.8	35.7
36	21	9.52	9.52	14.5	66.6
Pediatricians					
43	10	0.0	40.0	10.0	50.0
44	15	0.0	20.0	13.3	66.7
47	7	0.0	57.2	0.0	42.8
48	9	0.0	44.4	33.3	22.2

The chances for improvement seemed to be greatest when abscess was caused by: (1) tonsillectomy, 51.8 per cent improved; (2) other surgery, 33.3 per cent improved; (3) foreign body, 33.3 per cent improved; (4) pneumonia, 29.2 per cent improved.

The following symptoms are stated in order of highest frequency as chief complaint: cough, 171; pain, 125; fever, 93; hemoptysis, 55; chills, 51; sputum, 41; loss of weight, 32; dyspnea, 22; nausea and vomiting, 21; diarrhea, 12; weakness, 12; headache, 8; and night sweats, 6.

Table IV
ETIOLOGY OF THE REPORTED CASES OF LUNG ABSCESSES

	C	I	U	D	Total
Pneumonia	1	16	8	29	55
Tonsillectomy	1	16	7	7	31
Other surgery	0	8	4	12	24
Influenza	0	8	1	2	11
Foreign bodies	1	2	2	1	6
Abortions	1	0	0	3	4
Furunculosis of face	0	0	0	3	3
Otitis media	0	1	0	3	4
Whooping cough	0	1	0	2	3
Peritonsillar abscess	1	0	0	1	2
Stab wounds	0	1	0	0	1
Fractured skull	0	0	1	0	1
Ameba	0	0	1	1	2
Gunshot	0	0	1	0	1
Tooth extractions	0	0	1	1	2
Face injury	0	1	0	0	1
Thrombophelebitis	0	0	0	1	1
Vincent's angina	0	0	0	1	1
Fractured rib	0	0	0	1	1
Spinal puncture	0	0	0	1	1
Tularemia	0	0	0	1	1
Gasolene inhalation	1	0	0	0	1

Table V
OUTSTANDING CONDITIONS PRECEDING ONSET OF LUNG ABSCESSES

Author	No. of Cases	Pneumonia, Per Cent	Upper Respiratory Infection, Per Cent	E.N.T. Surgery, Per Cent	Other Surgery, Per Cent	Unknown, Per Cent
Allen and Blackman	94	18	....	24	10	38
Rives	100	61.8	....	21.8		
Cutler and Gross, 1936	90	28	....	39	14	14
Leuth and Sutten, 1936	101	13	30	10	....	30
Warner, 1938	98	20	....	30	....	33
Freedman, 1938	276	38	26	10	15	
Fisher and Finny, 1938	88	40	9	15	13	10
Charity Hospital, 1941	417	13	2.6	7.9	6	67
Sweet, 1940	125	20	....	49.5	11.0	10.0
Jackson	124	....	37	29	10.5	
Morrison	66	....	....	39	13	

Tables vii, viii, and ix deal with 250 cases of single lung abscesses designating the affected side. It will be noted that the right side was affected twice as often as the left, 165 (66.0 per cent) were right-sided abscesses and eighty-five (34.0 per cent) were left-sided abscesses. The lower lobes, whether right or left, were more frequently involved than the upper lobes. Of the 250 (59.9 per cent) cases of single lung abscesses, 155 (61.3 per cent) occurred in white admissions and ninety-seven (59.1 per cent) in negro admissions. There were ninety-seven (62.5 per cent) white patients and sixty-eight (70.0 per cent) negro patients with single abscesses on the right side. There were fifty-six (36.3 per cent) white patients and twenty-nine (29.8 per

Table vi
RESULTS OF LUNG ABSCESSES HAVING THE ETIOLOGY IN PREVIOUS SURGERY

	White				Colored				Total
	C	I	U	D	C	I	U	D	
Tonsillectomy	0	9	6	4	1	7	1	3	31
Amputation	0	0	0	2	0	0	0	0	2
Transurethral resection	0	0	0	3	0	0	0	1	4
Appendectomy	0	3	2	0	0	0	0	1	6
Ventral hernia	0	0	0	0	0	1	0	0	1
Plastic surgery	0	0	1	0	0	0	0	0	1
Herniplasty	0	0	0	0	0	1	0	2	3
Hysterectomy	0	0	0	0	0	0	0	1	1
Eye surgery	0	0	0	0	0	0	1	0	1
Sinus operation	0	0	0	1	0	0	0	0	1
Gastric resection	0	0	0	0	0	0	0	1	1
Exploratory laporatomy	0	0	0	1	0	0	0	0	1
Peritonsillar abscess	0	0	0	0	0	0	0	1	1
Total	0	12	9	11	1	9	2	10	54

Table vii
OCCURRENCE AND LOCATION OF SINGULAR ABSCESSES

	White		Colored		Total
	Male	Female	Male	Female	
Right Lung (165 or 66 per cent)					
Upper lobe	27	8	16	6	57
Mid lobe	16	7	6	1	30
Lower lobe	22	14	21	12	69
Not stated	..	..	..	..	9
	65	29	43	19	
Left Lung (85 or 34.0 per cent)					
Upper lobe	17	10	9	1	37
Lower lobe	18	10	13	4	45
Not stated	..	..	..	..	3
	35	20	22	5	

Table viii
CLASSIFICATION AS TO RACE, SEX AND OUTCOME IN *SINGULAR, RIGHT LUNG ABSCESSES*

	C	I	U	D	Total
White					
Upper	0	12	5	18	35
Mid	1	13	5	4	23
Lower	1	17	9	9	36
Undetermined	0	0	3	0	3
Total	2	42	22	31	97
Colored					
Upper	1	8	5	8	22
Mid	0	1	0	6	7
Lower	0	13	7	13	33
Undetermined	0	2	2	2	6
Total	1	24	14	29	68

Table ix
CLASSIFICATION AS TO RACE, SEX AND OUTCOME IN SINGULAR, LEFT LUNG ABSCESSES

	C	I	U	D	Total
White					
Upper	1	15	5	6	27
Lower	1	9	14	4	28
Not stated	0	1	0	0	1
Total	2	25	19	10	56
Colored					
Upper	0	3	1	6	10
Lower	1	5	2	9	17
Not stated	0	0	0	2	2
Total	1	8	3	17	29

cent) negro patients with left-sided abscesses. Of the patients with right-sided abscesses, there were thirty-one (31.9 per cent) deaths in the white group and twenty-nine (42.7 per cent) deaths in the negro group. The mortality rate for patients with left-sided abscesses was 17.8 per cent in the white group and 58.7 per cent in the negro group. The mortality rate for abscesses on the right side was approximately the same in both races, whereas, on the left side it was 40.9 per cent higher in the negro group, however, the death rate in all cases was higher in this group.

TABLE X

LOCATION OF SINGULAR LUNG ABSCESSES

Author	Right Lung			Left Lung		Total
	U	M	L	U	L	
Fisher	21 (35.6%)	11 (18.6%)	14 (23.7%)	14 (23.7%)	19 (32.2%)	59
Cutler	23 (25.5%)	5 (5.5%)	21 (23.5%)	20 (22.2%)	16 (17.7%)	90
Allen	14 (14.0%)	18 (18.0%)	30 (30.0%)	13 (13.0%)	23 (23.0%)	100
Kline	22 (21.7%)	10 (9.9%)	28 (27.7%)	13 (12.8%)	28 (27.7%)	101
Geay	16 (39.0%)	1 (2.4%)	7 (17.0%)	10 (24.4%)	7 (17.1%)	41
Freedman*	47 (16.3%)	28 (9.7%)	110 (38.1%)	36 (12.4%)	68 (23.8%)	289
Charity Hospital	57 (23.9%)	30 (12.6%)	69 (28.9%)	37 (15.5%)	45 (18.9%)	238

* Includes single and multiple abscesses.

Considering Table x which contrasts the location of single lung abscesses in the findings of several authors, only one group of statistics showed the medial lobe to be involved more frequently than the upper lobe. In three groups the upper lobe was involved more frequently than the lower lobe on the right side. However, on the left, two of three authors reported the upper lobe more frequently involved than the lower lobe. As illustrated by Table xi, the reports of these authors show no uniform distribution between death rates and lobe involved. If some constant factor could be found in this group, one could give a prognosis.

Table xii shows that of the total admissions 138 (33.0 per cent) had multiple lung abscesses, that is, either bilateral or multiple unilateral abscesses. Multiple abscesses occurred in seventy-six (29.9 per cent) of the total white admissions and in sixty-two (38.8 per cent) of the total negro admissions. It becomes apparent that the percentage of multiple abscesses is higher in negro admissions. There were fifty (65.9 per cent) white patients and fifty (80.7 per cent) negro patients who died from multiple lung abscesses.

Table xiii contrasts mortality rate in multiple and single abscesses. This shows that there were eighty-seven deaths in single lung abscess cases with forty-one (49.3 per cent) occurring in the white admissions and forty-six (45.5 per cent) in the negro admissions; similarly there were 100 deaths in multiple abscesses, 50 per cent occurring in the white admissions and 50 per cent occurring in the negro admissions. The percentage of deaths in races is substantially the same in both single and multiple abscesses. These figures are quite different from Reves' report of 88 per cent mortality in bilateral abscesses and 67 per cent in unilateral multiple abscesses.

Table xiv demonstrates the outcome when empyema occurred as a complication. The mortality rate was 81.5 per cent. This is twice the death rate for the entire series. However, Neuhof stated that when empyema occurred as a complication of the one-stage treatment of lung abscesses it did not enhance the mortality rate, whereas, this study shows that the mortality rate is twice that of the entire series.

It is of interest to note the outcome of those patients who were admitted either to a surgical service or a medical service and received attention only from the physicians of those respective services as compared with those who received simultaneous attention from both. Table xv shows the results in 417 cases of which 276 patients received medical treatment with a mortality rate of 51.0 per cent; eighty-six received surgical treatment with a 48.8 per cent mortality rate; and fifty-five received combined treatment with a 40.0 per cent mortality rate. This reveals that the mortality in surgical-medical care was approximately 10 per cent less than independent care; however, the percentage of unimproved cases is greater in surgical-medical care. The 10 per cent improvement loses its value when one considers the size of the sampling in the three contrasted groups.

Table xi

IMPROVED AND MORTALITY RATES IN LOBES INVOLVED

Author	U		M		L	
	I	D	I	D	I	D
Right Lung						
Geay............	12	2 (14.3%)	1	1 (50.0%)	4	4 (50.0%)
Cutler............	13	10 (43.5%)	2	3 (60.0%)	14	7 (33.3%)
Allen............	7	4 (36.3%)	14	4 (22.2%)	18	9 (33.3%)
Charity Hospital..	21	26 (55.3%)	15	10 (40.0%)	22	12 (35.2%)
Left Lung						
Geay............	6	3 (33.3%)	..	....	7	4 (36.3%)
Cutler............	14	6 (30.0%)	..	....	6	10 (62.5%)
Allen............	9	4 (30.7%)	..	....	13	8 (38.0%)
Charity Hospital..	12	17 (58.6%)	..	....	16	13 (44.8%)

Table xii

CLASSIFICATION AS TO RACE, SEX AND OUTCOME IN MULTIPLE LUNG ABSCESSES

	C	I	U	D	Total
White 76 or (29.9%)					
Right 26 or 34.3%.....	1	6	11	8	26
Left 11 or 14.5%.....	0	3	3	5	11
Bi-lat. 28 or 36.9%.....	0	1	0	27	28
Mil. 8 or 15.0%.....	0	0	0	8	8
Not stated 3 or 3.9%....	0	1	0	2	3
Total......	1 (1.3%)	11 (14.4%)	14 (18.4%)	50 (65.8%)	76
Colored 62 or 38.8%					
Right 26 or 41.9%.....	0	5	3	18	26
Left 14 or 24.5%.....	0	1	3	10	14
Bi-lat. 17 or 27.4%.....	0	0	0	17	17
Mil. 4 or 6.6%	0	0	0	4	4
Not stated 1 or 1.6%....	0	0	0	1	1
Total......	0	6 (9.7%)	6 (9.7%)	50 (80.6%)	62

Table xiii

MORTALITY RATE IN MULTIPLE AND SINGLE LUNG ABSCESSES

	White	Colored	Total
Multiple abscesses.....	50 (50%)	50 (50%)	100
Singular abscesses.....	41 (49.3%)	46 (45.5%)	87

Table xiv

OUTCOME IN EMPYEMA

	C	I	U	D	Total
White..................	1	4	1	18	24
Colored..................	0	1	1	17	19
Total..................	1	5	2	35	43

Table xv

COMPARISON OF TREATMENT

Treatment	C	I	U	D	Total
Surgical.....	3 (3.5%)	30 (34.8%)	11 (12.7%)	42 (48.8%)	86
Surgical medical...	1 (1.8%)	19 (34.5%)	13 (23.6%)	22 (40.0%)	55
Medical.....	8 (2.8%)	80 (29.3%)	47 (17.0%)	141 (51.0%)	276
					417

Considering the fact that this group of statistics does not contain the follow up results that are found in the majority of other similar studies, the following comparisons are not entirely justified. As to race, no other series contains as large a proportion of negro patients as this one. In Lueth's collection of 101 cases, eighteen (16.3 per cent) cases occurred in negroes as contrasted to 169 (38.8 per cent) in this series.

Table xvi
COMPARATIVE DEATH RATES OF LUNG ABSCESSES

Author	No. Cases	Died	Percentage
Lueth	101	40	39.6
Kline	90	40	44.5
Fisher	88	21	23.8
Warner	98	21	21.4
Allen	100	40	40.0
Cutler	90	32	35.5
Neuhof	45	2	4.4
Charity Hospital	417	205	49.1

The percentages of deaths in eight of the more recent statistics are given in Table xvi. Excluding Neuhof's group, the rest of the reports fall into the same category as to percentage of deaths, ranging from 21.4 to 49.1 per cent.

More recently the morbidity and mortality rates have been diminished by surgeons now capable of carrying out more difficult procedures such as lobectomy or pneumonectomy. Lindskog has verified this in a report of six cases, four being primary lobectomies and two secondary lobectomies following cautery pneumonotomy, all of which were cured. This procedure would seem to be more rational than any other after considering the pathological condition we are dealing with. In these abscessed lungs there is a marked walling off of the infected area to such an extent that even after the evacuation of the cavity there is failure of collapse of the wall. Also, there is a great deal of bronchiectasis in the surrounding bronchi which will continue to act as a foci of infection, thus making the eradication of the cavity impossible under the more conservative procedures. Therefore, it seems apparent that no other procedures, excepting lobectomy and pneumonectomy, could efficiently and satisfactorily eliminate the entire pathological process and thus insure the individual of complete recovery.

Table xvii
VARIOUS TYPES OF THERAPY AND RESULTS

	C	I	U	D	Total
Neoarsphenamine	0	31	11	23 (35.4%)	65
Bismuth	1	1	1	2 (40.0%)	5
Neoarsphenamine and bismuth	2	7	3	6 (33.3%)	18
Sulfanilamide	2	9	2	11 (45.8%)	24
Sulfapyridine	2	2	3	17 (70.8%)	24
Sulfathiazole	0	1	1	3 (60.0%)	5
X-ray	1	1	0	4 (66.6%)	6
Transfusion	0	16	6	33 (60.0%)	55
Emetine	0	7	0	3 (30.0%)	10
Lipiodol	1	12	16	11 (27.5%)	40
Bronchoscopy	0	13	12	7 (21.9%)	32
Foreign protein	0	2	2	5 (55.5%)	9

The medical treatments rendered these patients were numerous and those methods in which five or more trials were attempted are included in Table xvii. Lipiodol was included as a therapeutic measure because in some instances it was used in an attempt to sterilize the cavity. There were fifty-three patients receiving one of the sulfanilamide groups, of them, thirty-one (58.6 per cent) died. This is a relatively small group and the drug was administered in small doses. Of the eighty-two patients receiving neoarsphenamine or neoarsphenamine and bismuth in combination, twenty-nine (34.2 per cent) died. There were ten patients treated with emetine, of which,

Table xviii
TYPES OF SURGICAL PROCEDURES AND RESULTS OBTAINED

	C	I	U	D	Total
Thoracotomy	1	0	0	3	4
Rib resection one and two-stage	0	12	2	12	26
Thorocoplasty	1	0	0	0	1
Thorococentesis wet and dry	1	8	2	15	26
Artificial pneumothorax	0	6	3	8	17
Phrenicoeccersis	0	4	4	4	12
Total	3	30	11	42	86

two were demonstrated to actually have had ameba histolytica. One of them died. Bronchoscopic examinations were carried out by twenty-three surgeons and only two reported success in getting into the cavity.

There were eighty-six patients subjected to some surgical procedure, of these, forty-two (48.9 per cent) died, which is practically the same total mortality as that of the entire series. In Table xviii the various surgical procedures are outlined. There are twenty-six patients in whom rib resections were done, twelve (46.2 per cent) of whom died. This compares most unfavorably with Neuhof's report of 4.4 per cent mortality rate, the principal difference being that Neuhof applied a one or two-stage procedure as soon as he was certain of the type of disorder he was dealing with, whereas, it was done in this series as a last resort. Thoracentesis was done, and in many of these cases it was entirely unjustifiable because of negative *x*-ray reports, negative physical findings, and no presence of fluid on attempted aspiration. Artificial pneumothorax was attempted in seventeen cases, and in only six could an improvement be demonstrated. In eight of these cases empyeme followed its usage.

TABLE XIX

COMPARATIVE MORTALITY RATES IN SURGICAL PROCEDURES ARE CONTRASTED WITH RESULTS FROM OTHER INSTITUTIONS

Procedure	Leuth	Cutler	Allen	Sweet	Charity Hospital	Neuhof
Thoracoplasty	66%					
Artificial pneumothorax	100%	....	26.9%	......	47.0%	
Thoracocentesis	60%	....	......	24.6%	57.8%	
Phrenic nerve procedures	25%	100%	3.9%	......	1.1%	
Rib resection	57%	42.5%	27.7%	41.1%	25.0%	4.5%

Table xix denotes the comparative mortality rates in surgical procedures as done in several institutions. There are no uniform findings among the procedures outlined, the mortality rate in rib resection varying from 4.5 to 57.0 per cent, phrenic nerve procedures varying from 1.1 to 100 per cent, artificial pneumothorax varying from 26.9 to 100 per cent. There were no constant findings to indicate the preference of one procedure over another, excepting Neuhof's use of rib resection, nor is there an indication that any one group applied the most suitable procedure.

It will be noted that 113 of the 417 patients admitted had previously been treated at the Charity Hospital, and the results are presented below:

White				Colored			
C	I	U	D	C	I	U	D
0	23	56	7	0	8	12	7

The mortality rate in this group of patients was 12.4 per cent which was one-fourth the general mortality rate.

In this paper are presented the results of 417 cases of lung abscesses in respect to number, location, race, sex, and age distribution with the comparative findings of other investigators.

Forty-nine per cent mortality rate offers very little encouragement for the efforts put forth by the physicians that were in attendance with patients having lung abscesses at Charity Hospital in New Orleans. This inference can be drawn from the survey of this paper, that the methods of treatment employed during the period of time from 1931 to 1941, regardless of which one used at this institution, did not render satisfactory results.

SUMMARY

It was found in the review of 417 cases of lung abscesses that 268 occurred among white patients and 169 among negro patients, and that the majority of the patients were between thirty and fifty years of age. Of these cases, only twelve patients can be said to have been completely cured, and 205 (49.2 per cent) died. A greater mortality rate existed in the negro race. Multiplicity of abscesses and empyema seemed to increase the mortality rate.

Surgery and lung infections were equally contributory to the formation of lung abscesses which is quite contradictory to many similar reports which present surgery, especially that of the upper respiratory tract, as the outstanding etiological factor. The chances for recovery seem to be better in cases resulting from previous surgery rather than those resulting from infectious causes.

When surgical procedures were used in an effort to eradicate the abscess the mortality rate was 48.9 per cent. The medical treatments administered proved to be just as unsatisfactory, and one cannot state which yielded the best results.

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CONGENITAL HEMOLYTIC ICTERUS*

SURGICAL TREATMENT OF COMPLICATIONS WITH A REPORT OF TWO CASES

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THE spleen still richly deserves the designation applied to it by Galen, "An organ full of mystery." Even though it has been said that spleens were removed by the ancients to increase the wind of runners and from then on an occasional operation was done following bayonet and other wounds, it has been in the past fifteen years and more especially in the past ten that there has been great interest and progress in the development of the knowledge of diseases involving this organ.

The marked confusion of the anemias and other conditions associated with disturbances of the spleen that were obtained only a few years ago is rapidly being clarified and the diagnostic characteristics are constantly becoming more definite. Nevertheless, there are still many points in the treatment of hemolytic icterus and its associated complications that need study. Although there are numerous complications encountered such as the development of platelet crises (1), anemia, cholecystitis and cholelithiasis, optic atrophy, etc., my discussion hereafter will be limited to certain aspects of the disease that would be of interest to the surgeon operating upon these patients with particular emphasis on the treatment of hemolytic icterus complicated by cholecystitis and cholelithiasis.

HISTORICAL REFERENCES TO SPLENECTOMY

In Pliny's Natural History the first positive statement about removal of the spleen is made. Even as far back as the year 1680 splenectomy was successfully carried out on the dog by Zambeccari.[2] According to Moynihan,[3] the first splenectomy for hemolytic jaundice was done by Sir Spencer Wells[4] in 1887, and as reported by Lord Dawson[5] the patient was alive and well twenty seven years after operation and that her red blood cells still showed increased fragility. The second reported operation was done by Bland Sutton[6] in 1895. From the accounts of these cases the diagnosis seems to have been fitted later to the original description and subsequent course. Wilson[7] described hemolytic jaundice in 1890 as congenital jaundice associated with splenomegaly, but probably the first case diagnosed as hemolytic jaundice for which splenectomy was recommended was the one done by Banti[8] in 1903 and reported in 1912. Attention was first called to this disease in this country in 1910 by Griffin,[9] and since then there have been an ever increasing number of reports especially from the larger clinics.

ETIOLOGY AND CLASSIFICATION

The actual cause of the disease is unknown and the primary cause is evidently considered not to be in the spleen. There are two types described, the familial and acquired. According to Muelengracht[10] the familial type is inherited as a dominant factor while Haden[11] favors the hypothesis that in the familial type the microspherical red blood cells of increased fragility are inherited and thus more readily destroyed in the spleen resulting in hypertrophy of that viscus. Dawson, Lee and Palmer believe that the two types are the same. Watson[13] has determined that the most significant factor in distinguishing the familial or congenital from the secondary or acquired types to be the predominance of microcytes in the former and macrocytes in the latter. This distinction should depend on the measurement of the average diameter of the erythrocytes and not on simple inspection of the blood smears. Nesler[14] believes that the congenital and acquired forms differ at the time of onset, and in general the course of the acquired form is more severe. Wise[15] concluded that the acquired group of cases as so classified would in time be omitted and all cases recognized as congenital. In many patients there is no change in the fragility of the cells after splenectomy although the jaundice disappears, which is against the theory that hemolytic jaundice is a primary disease of the spleen. Most authorities[16,11] consider the disease to be an hereditary disorder of the red cell formation in the bone marrow with the production of small thick erythrocytes (spherocytes) as the salient feature. Dameshek[17] has advanced the concept that hemolytic jaundice is caused not by an intrinsic defect in the bone marrow, but rather by the action of hemolysins of various types and in varying "doses" on mature red blood cells.

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SIGNS, SYMPTOMS AND LABORATORY FINDINGS

The cardinal symptoms and signs of hemolytic jaundice, viz., acholuric jaundice, enlarged spleen, anemia, crises with pain and fever, increased fragility of the red cells, increased reticular cells, urobilin but not bilirubin in the urine, normal colored stools, increased icteric index, negative Van den Bergh reaction, and the absence of itching, are now well established; and although the diagnosis may at times be difficult, it can usually be made with reasonable certainty.

The blood yields the most important data of which the Bibierre or fragility test is diagnostic of the disease. The red cells as discovered by Chauffard,[18] show a diminution of resistance to hemolysis by hypotonic salt solution, that is an increased fragility. Normal hemolysis begins at 0.42 per cent and is complete at 0.32 per cent.

There is a secondary anemia which is likely to be more severe in women.[19] The degree depends upon the efficiency of the hemopoetic system.[20] It is chronic and usually moderate although during a crisis the hemolysis may reduce the number of red cells markedly. The color index is high but less than one. The number of white cells is normal but may be increased during and after a crisis. The differential count is unaltered but the red cells show anisocytosis with a predominance of microcytes. Evidence of blood regeneration is shown by an increase in the reticulocyte count.

A positive indirect Van den Bergh reaction is present as a rule, but a direct reaction may be obtained when there is associated disease of the bile ducts. The icteric index of the blood serum is increased and the serum usually contains urobilin. The Wassermann test may occasionally be strongly positive when no other evidence of syphilis is present. The test becomes negative after splenectomy and manifestations of lues do not develop subsequently.[21]

The urine contains urobilin, indicative of functional inadequacy of the liver cell. It does not contain bile. The stools are normal in color in the absence of complications and contain increased amounts of urobilin. The values of urobilin and urobilinogen in the duodenal contents, as determined by the Schneider test, are increased. This is an index of the blood destruction at a given time.[22]

Roentgenograms may reveal an enlarged heart, a delay in the formation of the centers of ossification and a widening of the bones with a thin cortex due to hypertrophy of the marrow tissue in its effort to keep up maximum erythrocyte production. The expansion of the medullary substance at the expense of the cortical bone is an observation characteristic of the congenital anemias in childhood.[23]

TREATMENT

It seems to be well established that the treatment of hemolytic jaundice is definitely surgical and consists of removal of the enlarged spleen. The experience of most surgeons justifies the statement that splenectomy can be done at quite early ages. Taylor,[24] in England, has reported splenectomy in children nine, eleven and thirteen months of age. Bell's[25] patient, aged fifteen months, is probably the youngest reported in America. Our youngest patient had a splenectomy at the age of four. Diamond[26] at the Childrens Hospital, in Boston, advocates early splenectomy for the infant or child with congenital hemolytic icterus. He reminds us of the fact that as the child passes through succeeding attacks of hemolysis, jaundice and anemia, there appears evidence of disturbance in function of organs other than the hemopoetic system as may be illustrated by the development of cholelithiasis at a later date.

The operative mortality is exceptionally low, especially in competent hands. Pemberton's[27] series from the Mayo Clinic, composed of 118 cases, shows a hospital mortality of 3.4 per cent. He has noted a decisive affection of the liver on the operative mortality and subsequent longevity. When the liver was affected the mortality was 5.4 per cent, and 80 per cent of the patients were living at the time this observation was made (1931). In the presence of a normal liver the mortality was 1.6 per cent and 90 per cent of the patients were living. He also reported that 86 per cent of the patients who survived the operation were living and 83 per cent in good health.

Following operation the jaundice and anemia usually improve progressively. It is noted that the fragility of the red cells in practically all cases remains greater than normal. Among clinicians there is almost universal agreement that gradual improvement in the red cell level follows splenectomy for hemolytic jaundice. The striking suddenness with which such changes occur was pointed out first by Glover and Fargo[23–28] and later by Doan[29] and his associates. In a few instances following operation the jaundice has recurred after several years, but it may be stated that, as a rule, the effect of splenectomy in hemolytic jaundice is permanent. However, the danger attributing a recurrence of jaundice to hemolytic icterus when it may be due to gallstones, or some biliary tract disease, must be clearly borne in mind. Too frequently this point is overlooked especially by the general practitioner and internist, who is more apt to see these patients when a recurrent jaundice occurs. Without doubt there is brought to our attention an occasional case of hemolytic jaundice with recurrent jaundice, abdominal pain and splenomegaly. Many of these patients have never had an investigation of their biliary tract. If only a simple Graham test were done, it might prove the gallbladder to be the seat of the trouble.

Although known by most surgeons very little attention has been focused on the importance of remembering that about 60 per cent of the long standing cases of hemolytic icterus have associated gallstones which may produce an obstructive jaundice resulting in the group of symptoms usually associated with this condition, including a direct Van den Bergh reaction. Diamond[26,31] encountered the presence of gallstones in two cases in a review of twenty-five cases of hemolytic jaundice in children. Frequently in childhood many cases of hemolytic jaundice with associated gallstones are not operated upon until they have suffered from continued hyperbilirubinemia which often leads to the production of gallstones and subsequent drainage from biliary obstruction.

In searching through available literature I found it relatively free of articles reporting cases or presenting emphasis on the importance of an associated cholilithiasis in hemolytic icterus.

Owen and North[32] have remarked that when disease is present in two organs simultaneously attention is apt to be centered upon that viscus which gives rise to the more conspicuous symptoms. Thus in coexistent cholilithiasis and hemolytic icterus, the associated and often symptomless gallbladder disease may be overlooked. This co-existence has been marked by numerous authors (Boyd, Balfour, Pool[33]). Donovan has noted that 60 per cent of the cases of hemolytic jaundice show pigment stones and suffer from attacks simulating biliary colic. Hence it is rather easy to understand why these patients have been operated upon for jaundice due to gallstones. Walton[34] is of the opinion that patients with hemolytic jaundice are born with red blood corpuscles which are above normal in shape and especially in fragility. Thus they are destroyed by the spleen so that jaundice and a profound secondary anemia develops. Owing to the increase in pigment in the blood stream, gallstones of the pigment type are almost certain to develop. Pemberton[27,35] in a review of the Mayo Clinic series of splenectomies for hemolytic jaundice, observed conclusive evidence of gallbladder disease with or without stones, in 69 per cent. In spite of this the advice of Moynihan[3,36] is not often followed by operating surgeons that "no operation for hemolytic icterus is complete until the bile passages have been thoroughly explored. Where both diseases are found, a rational treatment would seem to be splenectomy and cholecystectomy, in either one or two operations."

Wise,[15,37] in 1933, reported six cases of congenital hemolytic jaundice, five in one family, but made note of an associated cholilithiasis in one case only. In our experience at the Worcester City Hospital the presence of gallstones in hemolytic jaundice is much more frequent than the literature would seem to indicate. In a review of nine cases of hemolytic icterus of which five were subjected to splenectomy, seven were found to have associated gallstones. In the other two cases no reference was made to the presence or absence of stones although both patients had symptoms of cholecystitis with cholilithiasis. It is of interest to observe that of three cases occurring in one family, a father and two daughters, all had associated biliary tract disease. Both girls had submitted to splenectomy and cholecystectomy at different operations with very successful recoveries. The father refused operation but is still admitted to the hospital periodically suffering from splenomegaly, jaundice and upper abdominal pain.

Whether or not to perform the operation of cholecystectomy at the time of splenectomy should depend upon the judgment of the surgeon. Brooks and Clinton[38] reported a successful splenectomy and cholecystectomy at one sitting; the patient was a boy, four years of age. No reference was made as to the reason for simple drainage rather than removal of the gallbladder but it is probably true that at the age of four cholecystostomy would prove to be the wisest procedure. However, it is well known that these cases, especially children, may continue to reform stones from a continued hyperbilirubinemia, and may even drain stones through the cholecystostomy sinus. This is the type of case which I believe should be subjected at a later date to cholecystectomy if in the opinion of the surgeon the patient's condition justifies a second operation. A close follow-up is frequently overlooked, and once the patient leaves the hospital he often makes no further effort to return unless he has a recurrence of symptoms. Hence it should be impressed upon these patients that cholecystostomy is only a temporary procedure and does not offer a permanent cure. As is illustrated by our report Case II, the operation of choice was removal and not simple drainage of the gallbladder, to be performed by those trained in the technic of biliary surgery.

Owen and North[32] have reported two cases with co-existent cholelithiasis and hemolytic jaundice. In each case splenectomy and cholecystectomy were performed. In one instance the operation was performed in two stages; in the other, the operation was accomplished in one stage. Without doubt whenever possible the one-stage operation is to be preferred, but if not possible a two-stage operation is essential to the continued welfare of the patient.

As is reported in one of our cases perforation of the gallbladder sinus is extremely rare. To be sure perforation of the gallbladder itself is unusual, it being comparable to perforation of any other viscus. Judd[39] at the Mayo Clinic, in reviewing the cases of acute cholecystitis in which operation had been performed, found sixty-one in which the gallbladder had perforated. In only two of those was there extravasation of the contents into the general peritoneal cavity and one died. Eight of their patients had undergone cholecystostomy; there were six deaths in the entire series, half were associated with pulmonary complications. In the treatment of perforation with ensuing general peritonitis immediate surgical intervention is imperative. Rupture through the abdominal wall was observed in two cases, in both of which previous operations on the gallbladder had been performed. In these cases probably the viscus had been sutured to the abdominal wall at the time of the previous procedure or had become adherent in the scar.

Even in so large a group as that of the Mayo Clinic in no instance was there any note made of a perforated sinus tract following cholecystostomy with ensuing general biliary peritonitis. This type of rupture is extremely rare and worthy of reporting. Eliason[40] found nine perforations in 490 biliary admissions in a space of eleven years but no mention was made of a perforated cholecystostomy sinus tract.

Although calculous cholecystitis is encountered in the female patient many times more frequently than in the male, perforation of the gallbladder occurs in a higher relative proportion of male cases. Preoperative diagnosis is unusual as is shown by a review of the literature of the reported cases. In those cases in which there was widespread soiling of the peritoneum without localization of the lesion, diagnosis of perforated ulcer, ruptured appendix, and diffuse peritonitis of undetermined origin have been frequently made. Mitchell[41] states that before operation a correct diagnosis is made in only one out of sixteen cases. If the patient has previously been subjected to a biliary tract operation, the cause of the peritonitis would probably be more definite, especially if the type of operation had been that of drainage instead of removal. Realizing that perforation of the gallbladder is unusual but not the rare catastrophe it was once considered to be, more emphasis may justly be placed upon the necessity of urging all patients with attacks of recurrent calculous cholecystitis to submit to cholecystectomy while their gallbladder is quiescent. Delay on the part of both the patient and attending physician probably is responsible for the loss of many patients with this complication each year. In hemolytic icterus complicated by associated biliary tract disease the removal of delay in treatment is just as important as though both diseases were not co-existent.

Harkins[42] concludes that rapid death in biliary peritonitis is due to shock, a fall in blood pressure and blood volume and a decrease in blood concentration. Mentzer[43] believes that sterile bile is not the cause of death but that it is due to pyogenic rather than chemical peritonitis when it occurs. Ravdin[44] is of the opinion that in bile peritonitis there must be an opening and direct communication with the biliary passages.

COMMENT

In two cases reported herein, splenomegaly and jaundice were present together with cholelithiasis. Each case was in the younger age group, yet the presence of gallstones was an ever prominent factor in their symptomatology. In the first case reported splenectomy and cholecystectomy were performed in two stages with a successful recovery; in the second case splenectomy and cholecystostomy were accomplished in two stages, thirteen years apart, followed by a rupture of the cholecystostomy sinus into the general peritoneal cavity with resultant biliary peritonitis and death. Had the second patient submitted to cholecystectomy between the time of the first and second operations, or had a cholecystectomy rather than cholecystostomy been performed at the time of the second operation, the end result would in all probability proved to have been more favorable.

CASE REPORTS

Case I. M. C., a white female, aged sixteen years, was admitted to the Worcester City Hospital April 20, 1940, with a chief complaint of right upper quadrant pain of three months' duration. She had had measles and mumps as a child and no other serious illnesses. She was jaundiced at birth. Tonsils and adenoids were removed at the age of fourteen. Her menstrual history was normal. Her mother died at the age of twenty-one, cause unknown. Her father was living and well. He had periodic bouts of jaundice but otherwise was well.

The present illness dated back to birth at which time the patient was jaundiced, the jaundice having been present ever since, remaining approximately the same with minor variations in intensity at different intervals. It was definitely aggravated by intercurrent infections. Exclusive of spells of nausea, which were exaggerated whenever the jaundice became intense, the patient felt quite well until January, 1939, at which time she was admitted to the hospital complaining of abdominal pain of six months' duration. The diagnosis was cholecystitis with cholelithiasis, familial hemolytic jaundice.

After a considerable work-up the patient was subjected to splenectomy, and at operation after removing the spleen the gallbladder was palpated and found to contain a large stone in the ampulla. Presumably the patient's condition did not warrant further surgery and no biliary procedure was attempted. The patient's postoperative course was rather stormy with complications of wound sepsis, pneumonia and empyema of the left chest. Hemolytic streptococci were isolated from the chest fluid. Closed drainage was required followed by rib resection. The patient finally recovered after a hospital stay of almost four months. She felt fairly well until April, 1940, three months before entry for her present admission when she complained of attacks of right upper quadrant pain which have become more frequent keeping her awake at night. There was no jaundice or vomiting. Her bowels were regular and she was referred to the hospital for study and possible cholecystectomy.

Physical examination revealed a well developed and nourished young girl, in no acute distress. Temperature 99°F.; pulse 90; respirations 20. The essential findings were: moderate tenderness in the right upper quadrant, some spasm but no masses. Old splenectomy and thoracotomy scars were well healed.

Laboratory studies revealed: Hemoglobin 96 per cent; red blood count 5,160,000, white blood count 17,400 with 54 per cent polymorphonuclears, 39 per cent lymphocytes, reticulocytes 1.5 per cent; icteric index 15; red blood cell fragility .44–.42; Van den Bergh slightly positive-direct delayed; urine and blood chemistry normal.

The Graham test showed loss of gallbladder function with one calculus present. The patient was given seven days of preoperative preparation.

Cholecystectomy was performed with drainage. The abdomen was opened through a high right rectus muscle splitting incision. The liver was normal; the gallbladder was found to be covered with numerous thin adhesions and to contain one large calculus. Common and cystic ducts were patent. There were no stones and the gallbladder was removed without difficulty.

The patient was returned to ward in good condition. Convalescence was uneventful with very satisfactory recovery and she was discharged on the fifteenth postoperative day.

Eight months later the patient had fully recovered and had no complaints. She works as a waitress every day and feels fine. Recent blood counts are within normal limits.

Comment. This case serves to illustrate the point that a successful result can be obtained by adequate surgery on a patient with hemolytic jaundice and co-existent cholelithiasis. In this particular patient both splenectomy and cholecystectomy were performed at two different operations. The existence of an associated disease (gallstones) was recognized at the time of the splenectomy and a successful cholecystectomy was performed at a later date.

Case II. A. C., a white male, aged seventeen years, was admitted to the Worcester City Hospital February 23, 1940, complaining of generalized abdominal pain of thirty hours' duration; he had a draining post-cholecystostomy sinus of six months' duration and died February 26, 1940.

The patient had been a full term, spontaneous delivery at birth and had no noticeable icterus at birth. He suffered from no infectious diseases except measles at the age of three. He developed jaundice and an enlarged spleen at the age of four, at which time a diagnosis of congenital hemolytic icterus was made and a splenectomy performed. He was discharged improved but not cured. His reticulocytes were between 70 and 90 per cent. His fragility tests were at the upper limits of normal—0.05 per cent to 0.36. The red blood count was 3,000,000 to 2,700,000. His icteric index was of course increased. He evidently recovered satisfactorily and enjoyed fairly good health thereafter until his present illness, having had no further remissions.

His father was living and well, aged fifty-seven; his mother had died at the age of thirty, cause unknown. One brother died in infancy. Two male siblings were living and well. There was no jaundice or bleeding tendency in any family member and no other familial diseases.

About six months before entry the patient developed jaundice, vomiting and right upper quadrant pain. He was seen by a physician who stated that he had an acute cholecystitis and thence was referred to the hospital where a cholecystostomy was performed. Numerous small stones were removed from the gallbladder at operation. His general postoperative convalescence was slow but uneventful. However, through his cholecystostomy sinus he passed numerous small stones and he continued to drain bile up until six days before his present entry. His jaundice had disappeared. About twenty-four hours before admission the patient suddenly complained of severe right upper quadrant pain with radiation to the right shoulder followed in a few hours with radiation to the right lower quadrant and later becoming generalized over the entire abdomen. There was no history of vomiting but the patient stated that his urine had been dark for two days. His stools were brown. Showing no improvement at home he was referred to the hospital. Upon entry the sinus was draining bile and one day following he was jaundiced.

Physical examination revealed an acutely ill patient with a temperature of 102°F., pulse 140, respiration 36. The essential findings were: (1) sclera and skin were moderately icteric; (2) bronchovesicular breathing at the right base, no râles; (3) a small amount of stained fluid (bile) draining from the old cholecystostomy sinus opening; (4) definite spasm and tenderness to palpation over the entire abdomen, more pronounced over the right upper and lower quadrants. Laboratory studies revealed: hemoglobin 54 per cent (S); red blood count 3,800,000 two nucleated red blood cells per 100 white blood cells; white blood count 73,400 with 79 per cent polymorphonuclears, lymphocytes 5 per cent, non-segmented cells 10 per cent; hypochromia 2 plus, stippling 2 plus, polychormatophylia 1 plus, reticulocytes 12 per cent. The urine was slightly colored, bile 2 plus, sediment negative. Icteric index was 38. *X*-ray of the chest showed a spotty and cloudy infiltration in the right lung consistent with early pneumonia.

A diagnosis of rupture of the gallbladder or perforation of the cholecystostomy sinus tract with resultant biliary peritonitis was made. The patient was given intravenous 5 per cent glucose and saline solution and a blood transfusion in an attempt to improve his general condition. While lying in bed the patient appeared to have a considerable amount of respiratory embarrassment. The sinus tract opened up spontaneously a few hours after admission and drained a copious amount of bile and the patient felt markedly improved thereafter.

Exploratory laparotomy was performed under local and gas-oxygen anesthesia. The abdomen was opened through a mid-right rectus paramedian incision with removal of approximately two gallons of bile stained fluid. The loops of small bowel were adherent throughout and numerous adhesions were noted covering the area about the gallbladder. It was apparent that the patient's condition was extremely poor on the operating table and no further surgery could be accomplished. Two drains were inserted in the right lateral gutter for drainage. Culture was obtained of the peritoneal fluid.

The patient returned to the ward in poor condition. He was placed on the danger list and given further intravenous therapy. The pathological examination of the peritoneal fluid revealed the organisms to be Staphylococcus aureus and Bacillus pyocyaneus. The patient's condition, pulse and temperature rose steadily and his temperature to 106°F. He became quite toxic and expired on the second postoperative day. An autopsy was obtained.

At postmortem examination a fistula from the distal end of the gallbladder to the skin surface was found. About 2 cm. from the skin surface of the fistula was another sinus leading to the anterior and superior surface of the liver. This sinus was the source of the bile in the peritoneal cavity. The common and cystic ducts were patent. Numerous stones were found in the gallbladder, none in the ducts. Anatomical diagnosis: Hemolytic jaundice, operative absence of the spleen, bile peritonitis due to rupture of the sinus from the gallbladder, infectious hepatitis, perihepatitis, partial atelectasis of the right lung.

Comment. This case was included to illustrate the importance of complete exploration of the bile passages at the time of splenectomy, and that wherever possible cholecystectomy rather than cholecystostomy is the procedure of choice, especially in cholelithiasis with hemolytic jaundice. When both diseases are found, a rational treatment would seem to be splenectomy and cholecystectomy in either one or two operations. In this particular case, although the patient was only four years of age, no reference was made to the condition of the gallbladder. Without doubt this is a point frequently overlooked by surgeons and in all probability this patient would not have died had he been subjected to cholecystectomy at or about the time of splenectomy. Brooks and Clinton[38] reported a case of congenital hemolytic icterus with cholelithiasis in a patient four years of age, who had both splenectomy and cholecystostomy performed at one operation followed by cholecystectomy at a later date.

SUMMARY AND CONCLUSIONS

1. The occurrence of cholecystitis and cholelithiasis in hemolytic icterus is a frequently encountered complication.

2. Two interesting cases of congenital hemolytic icterus with an associated cholecystitis and cholelithiasis are reported in detail.

3. The gratifying result obtained in one is due to the rational judgment of the surgeon, that of complete exploration of the bile passages at the time of splenectomy. The fatal result in the other brings out a point so frequently overlooked by many surgeons; when both diseases are present a rational procedure would seem to be cholecystectomy and splenectomy in either one or two operations.

4. Splenectomy alone will not suffice in the treatment of hemolytic icterus complicated by an associated cholelithiasis.

5. Splenectomy with cholecystectomy rather than cholecystostomy is the operative procedure of choice and removal of the gallbladder is indicated more often than usually exists.

6. Although rare, rupture of a cholecystostomy sinus with resultant peritonitis does occur and when present the end result is frequently fatal.

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SALPINGITIS AND TUBAL PATENCY

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THE question of tubal patency and the most desirable method of determining it are still matters of discussion. The relation of tubal patency to the presence or absence of abnormal change has been given much less thought. Opinion is very definitely divided as to the relative merits of insufflation and hysterosalpingography. While there is general accord that hysterosalpingography gives much more definite information, many gynecologists believe that it also carries more potential hazards for the patient.

Possible complications of hysterosalpingography, listed by Bernardo Schaffer, are: Increase in endometriosis, increased tendency to ectopic pregnancy, toxic phenomena due to iodism, severe infection due to residual inflammatory processes, fat embolism, rupture of the tubes, and rupture of the uterus due to the presence of neoplasm. E. Leinziger lists the dangers as: (1) Chemical toxic, (2) mechanical, (3) embolic, and (4) inflammatory. In his opinion, hysterosalpingography should be done only as a hospital procedure. Yukio Hukata concludes that iodized oil stimulates edema, and that when iodized oil escapes from the Fallopian tubes it produces adhesions in nearby structures.

Comparable ill effects have, on the other hand, been reported with gas insufflation. Greenhill comments on a series of 600 Rubin tests performed by Healy, with three deaths in apparently normal women. All examinations were performed under ether anesthesia, and the deaths were in a group in which nitrous oxide and oxygen were used for insufflation. He deduces that some of these cases must have been hysterosalpingographies. While insufflation is the procedure of his choice, it is his opinion that the injection of iodized oil is practically harmless when properly performed.

Strong proponents of iodized oil are Leventhal and Solomon. They believe that when properly used, it carries a negligible morbidity, and is superior to gas insufflation both from a diagnostic and therapeutic standpoint. The number of pregnancies in their series is remarkable. Out of 114 patients with one or both tubes patent, fifty-one conceived. In nineteen cases with no demonstration of patency, three conceived. In the discussion of this paper, Dr. Ronald Crom summarizes the views of many in the following statement: "My conversion to lipiodol was due to the fact that tubes found to be impervious to carbon dioxide, repeatedly became patent to an oil substance at pressure below that used for gas insufflations. Second, more patients and many of those previously insufflated became pregnant. Third, peritoneal reactions to lipiodol when minimum quantities, 5 to 7.5 cc. were introduced, were no more common than after gas. Fourth, one can learn more about the condition of the uterus, tubes and ovaries than is the case with gas insufflations."

In my own work, while gas insufflation is frequently done, hysterosalpingography became the procedure of choice when in doubt. When the films of an increasing number of cases were studied in conjunction with the patients' histories and physical condition, it seemed possible to obtain more information than the mere matter of tubal patency. Little could be found in the literature, however, as to the significance and prognostic value of the various filling changes in the tubes. Many patients with patency on both sides give a history of repeated attacks of salpingitis, while others with complete bilateral blocking present an entirely negative history and are well.

In the available literature, the first attempt to correlate tubal patency, clinical and microscopic findings was reported by Watkins and Menne. Using both surgical and autopsy material from patients with chronic salpingitis, forty-nine tubes were injected with radio-opaque material and studied by x-ray. Of these tubes they found 30 per cent closed and 22 per cent narrowed in the intramural position. In the isthmian portion, 40 per cent were closed and 32 per cent narrowed. The fimbriated end was closed in 38 per cent of the cases. Occlusion seemed to depend on whether or not the fimbriae were adherent to the ovary.

An interesting and apparently valid explanation of the fact that tubes may be blocked at the cornu and the patient quite free from symptoms, is found in a paper by Falk, in which he recommends tubal resection for recurrent salpingitis. It is his contention that tubes tend to heal and sterilize themselves if not reinfected from below. Forty-three, 67 per cent, of the cases in which tubal resection was done were reported as clinically cured, or asymptomatic. Sixteen cases, or 24 per cent, had slight symptoms, and five cases, or 7 per cent, had definite complaints.

In a previous communication, I have described a method of obtaining a graphic record of the amount of uterine mobility by a minor variation from the usual technic of hysterosalpingography. This method was used in a series of 200 hysterosalpingographies. In order better to correlate radiographic findings with actual tissue changes, it was decided to review this series. The past history, the physical findings, and, as far as possible, the end results were listed together with the filling defects noted.

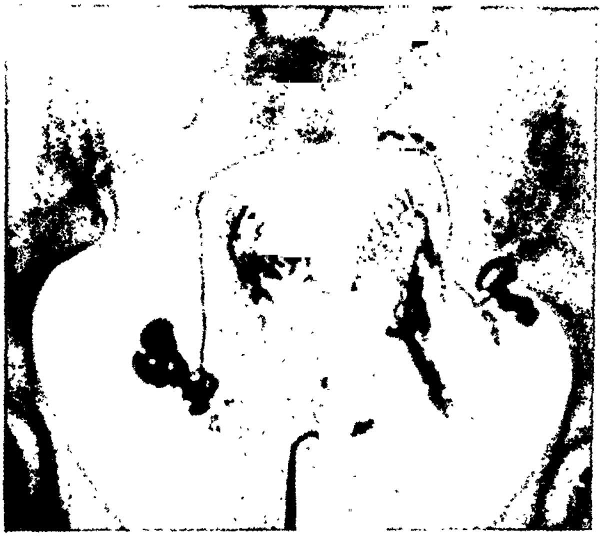

Fig. 1. Film not a part of this series but shown through the courtesy of an associate. Vascular filling and apparent perforation; no ill effects.

Thirty-five of the films were rechecks, leaving 165 patients to be considered. All of these films were made as an office procedure, and in no case there was sufficient reaction to prevent the patient coming in for her twenty-four hour film, or from carrying on her regular occupation. All injections were made through a soft tipped cannula and manometric control was not used. Injections were made very slowly and gently and after 3 to 4 cc. a film was exposed, developed and viewed before proceeding. Injection was discontinued, however, and a film made, regardless of the amount injected, if the patient complained of severe pain.

At first the series consisted solely of sterility studies, but more recently I have extended the indications to include patients with recurrent salpingitis who desired children. There were several reasons for this step. As my experience grew, I found in sterility studies that hysterosalpingography in patients with a previous history of salpingitis evoked no more reactions than in any other patient, provided the condition was quiescent. Secondly, such a study in a group of patients who required salpingectomy offered an opportunity to compare the radiographic with the surgical and pathologic picture. Also, in many border-line cases much time might be saved in deciding whether child-bearing was possible or probable, and whether conservative treatment should be continued or surgery advised.

Apart from the present series but interesting in demonstrating complications that may arise, and also that they are less serious than commonly considered, is a film (Fig. 1) made in my office by an associate, a gynecologist of unquestioned ability and experience. Contrary to custom, for some reason, this film was not carefully studied until after the patient had returned the following day for her twenty-four hour check. In the fundus there appears to be a perforation from the cannula with oil pouring through the perforation. In addition the vascular channels are filled with oil. Inquiry developed the fact that the patient experienced one sharp pain during the procedure, but felt quite well afterward and continued her occupation as a war worker on the following day without symptoms or complications of any kind.

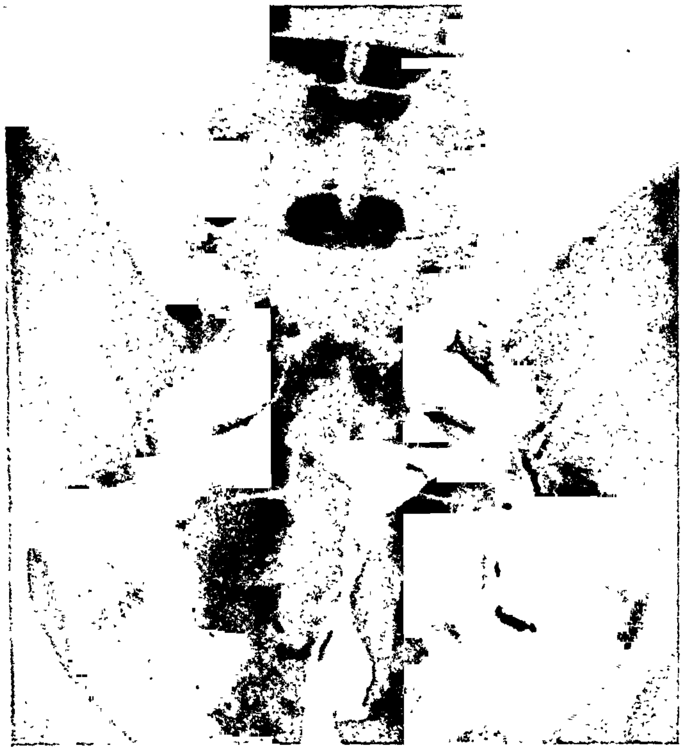
Fig. 2. Case No. 155. Left-sided salpingitis; narrowing and stricture of tube; polyp near left cornu causing spotting; patient had an unsuccessful curettage prior to her referral.

To facilitate analysis the cases are tabulated in series; patency or blocking at cornu, isthmus and fimbria is designated, together with information as to the patient's condition. Many of the patients listed as recurrent salpingitis presented only minimal symptoms which were relieved by occasional treatment. In all patients subjected to surgery, findings were confirmed by tissue examination and the patients were all relieved of their symptoms.

In the present series of 165 patients, there were twelve pregnancies, and eighteen on whom bilateral salpingectomy was done. In all patients subjected to surgery, all tubes were studied by serial sections, by Dr. James D. Edgar, head of Department of Pathology, Mercy Hospital, San Diego, California.

All but four of these patients had some degree of tubal patency, but in no case at surgery was there found any evidence of irritation from the iodized oil. As previously mentioned, none of these patients presented any untoward reaction from the examination; however, no such examination was made until the patient was temperature free and quiescent for several weeks and could withstand a fairly vigorous bimanual examination without reaction.

It is quite probable that there would have been a larger number of pregnancies had it not been for the war. No doubt some families are deferring pregnancies for the time being, and other families are separated.

There were twenty-nine women with both tubes completely patent and with entirely negative history and findings. There was only one pregnancy in this group, but it may be added that disturbances of ovulation were quite frequent in the same group.

With both tubes patent but some history of salpingitis, there were seventy-four patients. In this group tubes were listed as patent, provided they were permeable to oil, even though there was evidence of partial obstruction. From serial films it appeared that many of these tubes had been opened by pressure of the oil. Of these women, nine became pregnant and seven were subjected to surgery. The number of pregnancies is greatest in this group and most pregnancies followed shortly after hysterosalpingography. Very possibly mechanical opening may have been a factor. All of the pregnancies reported were normal uterine and no cases of ectopic gestation were encountered.

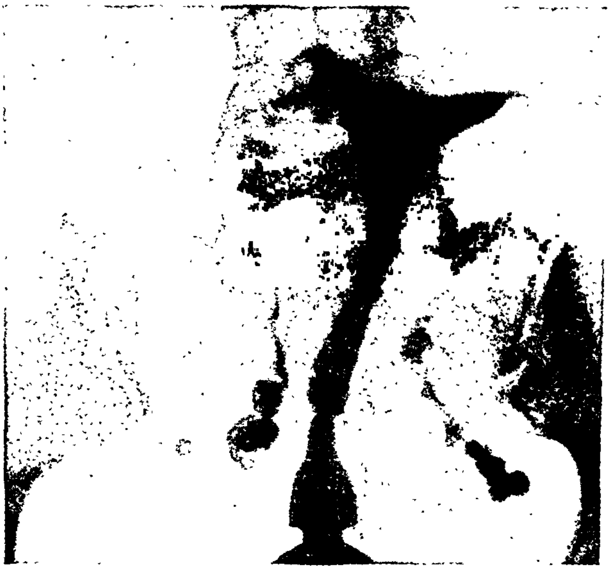
Fig. 3. Case No. 136. Recurrent bilateral salpingitis; large low hanging tubes; both tubes patent; beading and dilation at extremities.

In five patients one tube was found to be patent with the other blocked at the cornu. None of these patients could recall any definite attacks of pelvic disease although all admitted occasional pelvic pain during childhood and puberty. In this group no evidence of salpingitis was found on pelvic examination and two became pregnant shortly after study.

There were twenty-one women with one tube patent and the other blocked at the cornu who complained of pain on the patent side. Most of these patients stated that their pain had previously been bilateral or even more severe on the opposite side. Physical examination confirmed the diagnosis of salpingitis on the patent side. In this group there were no pregnancies and seven of these women required surgical relief.

In four patients with one tube blocked at the cornu there were bilateral symptoms and one patient with one tube blocked at the cornu presented symptoms on the same side. In all of these women the symptoms were mild in nature and may have been maintained through the lymphatics.

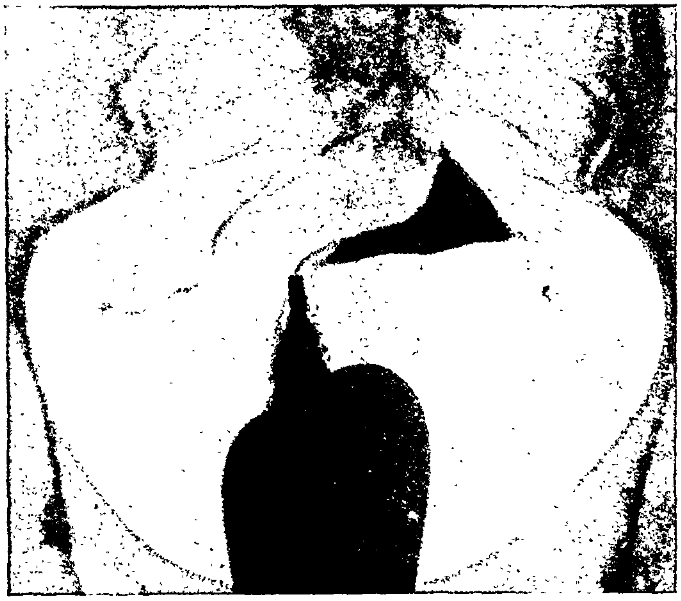

Fig. 4. Case No. 165. Recurrent bilateral salpingitis; surgery; both tubes partially patent; narrowing of tubes with displacement of uterus.

One patient had one tube patent and the other blocked at the isthmus. About a year prior to her sterility study a large right ovarian cyst was removed and a portion of the tube was removed with the cyst. She has not become pregnant and further study shows the majority of her cycles to be anovulatory. There were no history, symptoms or findings characteristic of salpingitis in this patient.

Five women had one tube blocked at the fimbriated extremity and one of these required radical surgery for relief of her symptoms. In these cases there had obviously been at some time a sufficiently severe inflammatory process to cause the fimbriae to adhere to the ovary or other adjacent structures.

An interesting group consists of eleven women with both tubes blocked at the cornu. One of these patients required surgery for the relief of her symptoms. The other ten were free from symptoms and significant clinical findings at the time of study. These ten were sterility studies in which gas would not pass and here again further questioning developed the presence of vague undiagnosed pelvic pain in their earlier years. It seems probable that in these patients a pre-existing salpingitis had healed after occlusion at the cornu.

Two patients presented bilateral isthmial blocking. One of these had mild recurrent salpingitis. In the other there had been a gonorrheal salpingitis followed by a bilateral hemisalpingectomy. She is quite well at the present time.

In eight patients one tube was blocked at the cornu and the other at the fimbriated extremity. Five of these were well and without any significant physical findings at the time of study. Two of the three presenting symptoms required operation.

Four patients had both tubes blocked at the fimbriated extremities. Three of these were free from symptoms and had no definite history of salpingitis. The other has had a bilateral salpingectomy.

Many of the patients with one tube blocked at the cornu gave a history of previously having had symptoms on the blocked side. It is significant to note that of eleven women with bilateral cornual blocking ten were well.

One additional finding of interest is the fact that a fair number of women find their symptoms relieved by hysterosalpingography. There has been neither sufficient time elapsed nor a sufficient number of cases to evaluate properly this finding. Whether this improvement is due to the possible hydraulic opening of the tubes or to the local effect of the oil is impossible to determine. In view of the varied treatments many of these patients have had, I cannot consider the effect entirely psychic.

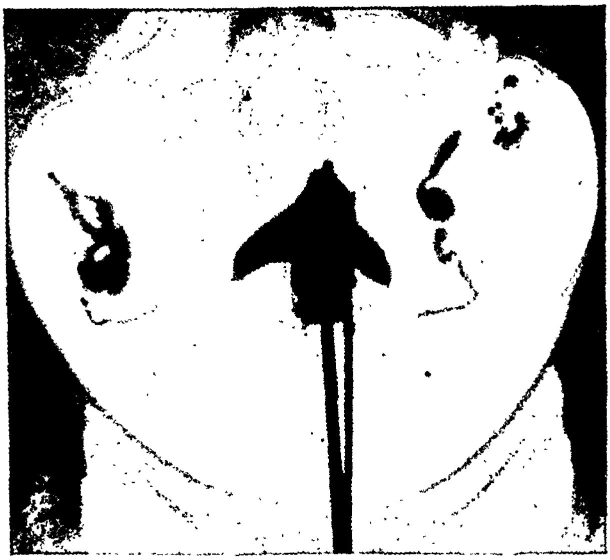

Fig. 5. Case No. 131. Recurrent bilateral salpingitis; surgery; both tubes patent but elongated with clubbing and adhesions at extremities.

When the tubes are patent in the presence of definite salpingitis the most characteristic radiologic findings are elongation, redundancy and clubbing of the extremity and areas of narrowing. Usually the uterus is displaced to one side, probably due to contraction of a previous inflammation. The tube on that side may be narrowed or beaded near the uterus, the midportion looped or convoluted, and the fimbriated extremity low and often partially obstructed. The opposite tube is elongated and usually narrowed and may show similar changes at the extremity. In spite of their permeability pregnancy was rare in this type of tube.

The films selected (Figs. 2, 3 and 4) from this series for presentation show these changes fairly well. The not infrequent findings of tubal occlusion in young women that are symptom free and without history of infection suggest the possibility of a blood or lymph-borne salpingitis during childhood or adolescence. It may be that some of the vague, lower abdominal pains in young girls are an unrecognized salpingitis.

SUMMARY

In determining tubal patency, hysterosalpingography, when properly done, even in the presence of salpingitis, carries no more risk than any other diagnostic procedure. While it carries more possible complications, the morbidity is negligible, and it is superior to gas insufflation from both diagnostic and therapeutic standpoints.

In the presence of salpingitis of sufficient duration and severity to warrant surgery, but in which preservation of child-bearing function is desired, this procedure is of value in deciding between continued local treatment and surgery.

	Right C.I.F.	Left C.I.F.	
1. C. A.	000	000	Mild recurrent bilateral salpingitis
2. T. A.	000	000	Mild recurrent bilateral salpingitis
3. F. B.	000	000	Negative findings. Negative history
4. L. B.	000	000	Mild recurrent bilateral salpingitis
5. J. B.	000	000	Mild recurrent bilateral salpingitis
6. C. J. B.	000	000	Mild recurrent salpingitis
7. E. B.	B—	B—	Previous salpingitis, now well
8. M. B.	000	B—	Now has right salpingitis
9. L. H. B.	000	000	Pregnancy
10. M. F. B.	000	000	Previous G. C., salpingitis; pregnancy
11. L. B.	00B	00B	Bilateral abscesses; surgery
12. O. L. B.	000	000	Bilateral salpinigitis
13. G. B.	000	000	Bilateral salpingitis
14. P. B.	000	000	Negative findings and history
15. P. I. B.	000	000	Negative findings and history
16. J. R. B.	000	000	Bilateral salpingitis
17. G. M. C.	000	000	Negative findings and history
18. R. G. C.	000	000	Bilateral salpinigitis; pregnancy
19. L. R. C.	000	000	Bilateral salpingitis; surgery
20. C. L. C.	000	000	Bilateral salpingitis
21. W. F. L.	000	000	Negative history and findings
22. B. C.	000	000	Negative history and findings
23. L. C.	000	000	Bilateral salpingitis
24. A. C.	000	000	Negative history and findings
25. D. C.	000	000	Bilateral salpingitis
26. L. C.	B—	000	L. Salpingitis; surgery
27. S. C.	000	000	Uterus didelphys; bilateral salpingitis
28. E. C.	B—	B—	Previous salpingitis; well at present
29. B. C.	000	000	Bilateral salpingitis; surgery
30. E. D.	000	000	Negative history and findings
31. S. J. D.	000	000	Bilateral salpingitis
32. C. D.	000	000	Bilateral salpingitis
33. E. L. D.	000	000	Bilateral salpingitis
34. V. D.	B—	00B	Previous salpingitis; well at present
35. M. D.	000	000	Bilateral salpingitis
36. M. C. D.	000	000	Negative history and findings
37. B. D.	000	000	Negative history and findings
38. E. D.	000	000	Bilateral salpingitis
39. F. D.	00B	B—	Bilateral salpingitis; surgery
40. F. E.	000	B—	Right salpingitis
41. M. E.	B—	B—	Previous G. C.; salpingitis; well at present
42. J. E.	000	000	Bilateral salpingitis
43. L. F.	000	000	Bilateral salpingitis
44. A. L. G.	000	000	Bilateral salpingitis
45. W. E. G.	000	000	Bilateral salpingitis
46. W. I. G.	000	000	Negative history and findings
47. M. G.	000	000	Bilateral salpingitis
48. D. G.	000	000	Bilateral salpingitis
49. M. H.	000	000	Negative history and findings
50. R. H.	000	000	Bilateral salpingitis
51. C. H.	000	000	Right salpingitis
52. M. H.	00B	00B	Puerperal infection; well at present
53. H. H.	B—	00B	Previous salpingitis; well at present
54. G. H.	000	000	Bilateral salpingitis
55. M. H.	00B	000	Bilateral salpingitis
56. C. E. H.	000	000	Right salpingitis
57. V. F. H.	000	B—	Pregnancy
58. E. H.	000	000	Salpingitis; pregnancy
59. L. I.	000	000	Salpingitis; pregnancy
60. L. J.	000	000	Bilateral salpingitis
61. E. J.	000	000	Right salpingitis; surgery
62. F. J.	B—	000	Left salpingitis; surgery
63. J. J.	000	000	Bilateral salpingitis; surgery
64. A. J.	000	000	Negative history and findings
65. D. K.	000	000	Previous severe G. C.; salpingitis; well now
66. M. K.	000	000	Left salpingitis
67. T. K.	000	000	Previous salpingitis; pregnancy
68. W. K.	000	000	Bilateral salpingitis
69. E. L.	B—	000	Left salpingitis; surgery
70. J. L.	B—	000	Left salpingitis; previously on right
71. M. L.	000	000	Bilateral salpingitis
72. H. L.	000	000	Bilateral salpingitis
73. L. L.	000	000	Bilateral salpingitis
74. A. L.	000	B—	Right salpingitis
75. F. L.	000	000	Bilateral salpingitis
76. G. M.	000	000	Bilateral salpingitis
77. P. McK.	000	000	Negative history and findings
78. C. M.	000	000	Bilateral salpingitis; surgery
79. B. F.	000	B—	Right salpingitis
80. A. B.	B—	000	Left salpingitis; surgery
81. V. S.	B—	B—	Previous salpingitis; well now
82. L. W.	B—	B—	Bilateral salpingitis; surgery
83. S. E.	000	000	Bilateral salpingitis
84. D. L.	00B	000	No salpingitis; previous right oophorectomy
85. H. K.	000	000	Negative history and findings
86. R. M.	000	000	Negative history and findings

		Right C.I.F.	Left C.I.F.	
87.	J. M.	ooB	ooB	Previous G. C.; salpingitis; well now
88.	E. M.	ooo	B—	Right salpingitis; previously on left
89.	V. McF.	ooo	ooo	Negative history and findings; pregnancy
90.	M. M.	ooo	ooo	Previous G. C.; salpingitis; well now
91.	H. M.	ooo	B—	Negative history; has large left ovarian cyst
92.	L. M.	ooo	ooo	Negative history and findings
93.	A. N.	ooo	ooo	Bilateral salpingitis
94.	A. H. N.	ooo	ooo	Negative history and findings
95.	B. N.	ooo	ooo	Bilateral salpingitis
96.	C. M. N.	ooo	ooo	Bilateral salpingitis
97.	F. O.	ooo	B—	Right salpingitis
98.	J. P.	ooo	ooo	Bilateral salpingitis
99.	W. H. P.	B—	ooo	Bilateral salpingitis
100.	M. P.	ooo	ooo	Bilateral salpingitis
101.	I. P.	B—	B—	Previous salpingitis; well now
102.	A. P.	B—	ooB	Previous salpingitis; well now
103.	J. P.	B—	ooo	Left salpingitis
104.	C. F. P.	oB–	oB–	Previous bilateral hemisalpingectomy; well now
105.	B. P.	B—	ooo	Bilateral salpingitis
106.	R. P.	ooo	B—	Negative history and findings
107.	O. P.	ooo	ooo	Bilateral salpingitis
108.	B. W. P.	ooo	ooo	Bilateral salpingitis
109.	C. W. R.	B—	ooB	Well now, previous salpingitis
110.	C. R.	ooo	ooo	Negative history and findings
111.	A. R.	ooo	ooo	Negative history and findings
112.	M. R.	B—	ooB	Left salpingitis
113.	K. R.	B—	ooB	Negative history and findings
114.	E. R.	ooo	ooo	Bilateral salpingitis
115.	L. R.	ooo	ooo	Bilateral salpingitis
116.	J. R.	ooo	ooo	Previous salpingitis; well now
117.	W. S. R.	ooo	B—	Right salpingitis
118.	L. R.	ooo	ooo	Bilateral salpingitis
119.	M. R.	ooo	ooo	Negative history and findings
120.	W. R.	B—	ooo	Right salpingitis
121.	D. R.	ooo	ooo	Negative history and findings
122.	E. R.	ooo	ooo	Negative history and findings
123.	J. S.	ooo	ooo	Bilateral salpingitis
124.	G. S.	oB–	oB–	Bilateral salpingitis
125.	M. S.	ooo	ooo	Bilateral salpingitis; surgery
126.	D. S.	ooB	B—	Bilateral salpingitis; surgery
127.	D. E. S.	ooo	ooo	Bilateral salpingitis; pregnancy
128.	N. S.	ooo	ooo	Bilateral salpingitis
129.	M. S.	ooo	ooo	Bilateral salpingitis
130.	M. A. S.	ooo	ooo	Bilateral salpingitis; surgery
131.	A. S.	ooo	ooo	Bilateral salpingitis; surgery
132.	E. S.	B—	B—	Bilateral salpingitis; well now
133.	L. S.	ooo	B—	Right salpingitis
134.	R. S.	ooo	ooo	Negative history and findings
135.	W. S.	ooo	ooo	Negative history and findings
136.	M. F. S.	ooo	ooo	Bilateral salpingitis
137.	H. L. S.	ooB	ooB	Bilateral salpingitis
138.	J. F. S.	ooo	ooo	Negative history and findings
139.	H. S.	ooo	ooo	Bilateral salpingitis
140.	R. E. S.	ooo	ooo	Bilateral salpingitis
141.	D. T.	ooB	ooo	Bilateral salpingitis
142.	D. E. T.	ooo	ooo	Bilateral salpingitis; pregnancy
143.	G. T.	B—	B—	Negative history and findings
144.	G. H. T.	B—	B—	Previous salpingitis; well now
145.	J. T.	ooo	ooo	Bilateral salpingitis
146.	F. T.	ooo	ooo	Bilateral salpingitis
147.	D. V.	B—	ooo	Well; previous tubal plastic
148.	B. V.	ooo	ooo	Bilateral salpingitis; pregnancy
149.	M. W.	B—	ooo	Left salpingitis
150.	E. W.	B—	ooo	Bilateral salpingitis
151.	L. W.	ooo	B—	Right salpingitis
152.	B. W.	oB–	ooo	Well; previous right hemisalpingectomy
153.	R. W.	ooo	B—	Right salpingitis
154.	J. W.	ooo	ooo	Bilateral salpingitis
155.	O. S. W.	B—	ooo	Left salpingitis
156.	A. M. W.	ooo	ooo	Negative history and findings
157.	M. B. Y.	B—	B—	Previous salpingitis; well now
158.	M. R.	ooo	B—	Right salpingitis; surgery
159.	M. C. B.	ooo	ooo	Bilateral salpingitis
160.	V. G.	ooo	ooo	Negative history and findings
161.	W. H.	ooo	B—	Right salpingitis; surgery
162.	A. J. W.	ooo	ooo	Bilateral salpingitis
163.	K. Y.	B—	B—	Well now; previous salpingitis
164.	U. W.	ooo	B—	Salpingitis; pregnancy
165.	M. I.	ooo	ooo	Salpingitis; surgery

A series of 165 patients was reviewed. Radiographic findings were compared with the surgical and pathologic picture. There were twelve pregnancies and eighteen on whom bilateral salpingectomy was done. In all those coming to surgery, definite tissue changes were found, and all patients were free from symptoms after surgery.

Salpingitis may be present even though a tube is permeable. Such tubes present certain characteristic radiologic features, such as elongation, clubbing and redundancy at the extremity, and areas of stenosis and dilation. Pregnancy is rare in this type of tube in spite of its permeability.

Occlusion at the cornu prevents reinfection from below and as a general rule results in self-sterilization and healing of the tubes.

There were twenty-nine women with both tubes completely patent, with entirely negative history and findings. Disturbances of ovulation were quite frequent, with only one pregnancy in the group.

Seventy-four patients had both tubes patent but some history of salpingitis. In this group tubes were listed as patent, provided they were permeable to oil, even though there was evidence of partial obstruction. From serial films it appeared that many of these tubes had been opened by pressure of the oil. Of these, nine patients became pregnant and seven were subjected to surgery.

Of five patients with one tube patent and the other blocked at the cornu, with negative history and findings, two became pregnant.

Twenty-one women had one tube blocked at the cornu, with symptoms on the patent side. There were no pregnancies and seven of these required surgery.

With one tube blocked at the cornu, four cases had bilateral symptoms, and one case presented symptoms on the same side. One patient had one tube patent, and the other blocked at the isthmus, following removal of a large ovarian cyst.

Five women had one tube blocked at the fimbriated extremity, and one of these required surgery.

Of eleven cases with both tubes blocked at the cornu, ten were well and the other well after operation.

Two patients had both tubes blocked at the isthmus. One had previously a bilateral hemisalpingectomy and is well; the other had mild recurrent salpingitis.

Eight women had one tube blocked at the cornu and the other blocked at the fimbriated extremity. Five were free from symptoms, and two of the three with symptoms required operation.

Four patients had both tubes blocked at the fimbriated extremities; three are well and the other has had a bilateral salpingectomy.

The not infrequent radiologic findings of tubal damage in young women with completely negative histories and tubal findings suggests the possibility that the vague lower abdominal pains often complained of during childhood and adolescence may be the result of an unrecognized blood or lymph-borne salpingitis.

In a number of cases with a record of previous varied treatments, symptoms have been relieved by hysterosalpingography.

Tubal patency can be and often is coincidental with salpingitis, although the majority of such tubes are not completely patent. Cornual occlusion usually results in self-sterilization and self-healing.

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PLASMA FIXATION OF SKIN GRAFTS

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THE covering of defects by free full thickness skin grafts has been developed during the past twenty years from a status in which there was no more than a 50 per cent success with small grafts, to one in which, even with large grafts, there is hardly ever a failure. Contributory to this improvement were, first, the recognition that restoration in the moribund graft was effected by arterial infiltration from the tissues of the base; second, that pressure must be adapted to promotion of such infiltration, not too little or the contact would be broken and not too much or the arterioles could not penetrate. It was observed that the infiltration went better when excision was made not only of the subcutaneous fat but also a segment of the corium.

The graft was cut according to the pattern of the defect. It shrank and must, therefore, be sutured in place, and this necessarily under tension. It was at first assumed that the graft when raised should be washed in saline solution to get rid of the sera. In my own experience, it was clearly better to allow the graft to rest a while in its own sera and that of the donor area. This was due, first, to the fact that such sera were a temporary protection against infection and, second, that they ensured a fibrinous adhesion between graft and host during what might be a critical twenty-four hours or more.

In her researches into the behavior of tissues, Dr. Machteld E. Sano, at Temple University, Philadelphia, has enlarged upon this last factor to an extent that quite probably has altered the whole technical plan. By painting the host with plasma and the graft with leucocyte cell extract, the adhesion is perfect, the sutures are unnecessary, the degree of pressure is no longer a problem, and the circulation within the graft is established so rapidly that overlapping edges bleed when cut on the second day. On the fourteenth day, as a rule, definite recovery is achieved and in two months the graft is indistinguishable, in coloration or by its boundaries, from the neighboring skin. As this applies to every order of graft (and to some other conditions) application of the principle involved obviously constitutes a revolutionary advance in the art of skin grafting. I present some observations derived from my own experience that bear upon its use in reparative practice.

To begin with, the patient supplies his own plasma and cell extract. As a working detail, it is well to mention that this should be at the time of operation. If the blood which provides them is taken the day before, it loses some of its restorative quality by the time it is used. As the amount is only 5 cc., its being taken at operation can have no ill effect.

The blood is withdrawn by an aspiration needle from the vein into a syringe of 10 cc. capacity. To maintain its fluidity when under treatment later, 1 mg. of heparin and 1 cc. of Tyrode's solution* are placed in the syringe before the aspiration.

The contents of the syringe are transferred to a centrifuge tube. This, balanced by one of alcohol in equal volume, is centrifuged by any electrical apparatus for twenty minutes. In the tube there will then be a physical division of the blood, the blood plasma on top, the red cells at the bottom, and a thin film of the white cells between. (Fig. 1.) The plasma is drawn off by pipette and syringe and inserted in another tube. (Fig. 1B, C.) The film of leucocytes in the first tube is scooped off and deposited in still another tube, into which there have been dropped 1½ cc. of Tyrode's solution, and also a few glass beads to facilitate shaking the contents. (Fig. 1D, E.) The tubes containing the plasma and cell extract are set in cool water.

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* Tyrode's solution consists of sodium chloride, 8.0 Gm, potassium chloride, 0.2 Gm., calcium chloride, 0.2 Gm., magnesium chloride, 0.1 Gm., sodium acid phosphate, 0.05 Gm., sodium bicarbonate, 1.0 Gm., glucose, 1.0 Gm., with distilled water added to make 1,000 cc.; filtered through Berkefeld filter "W".

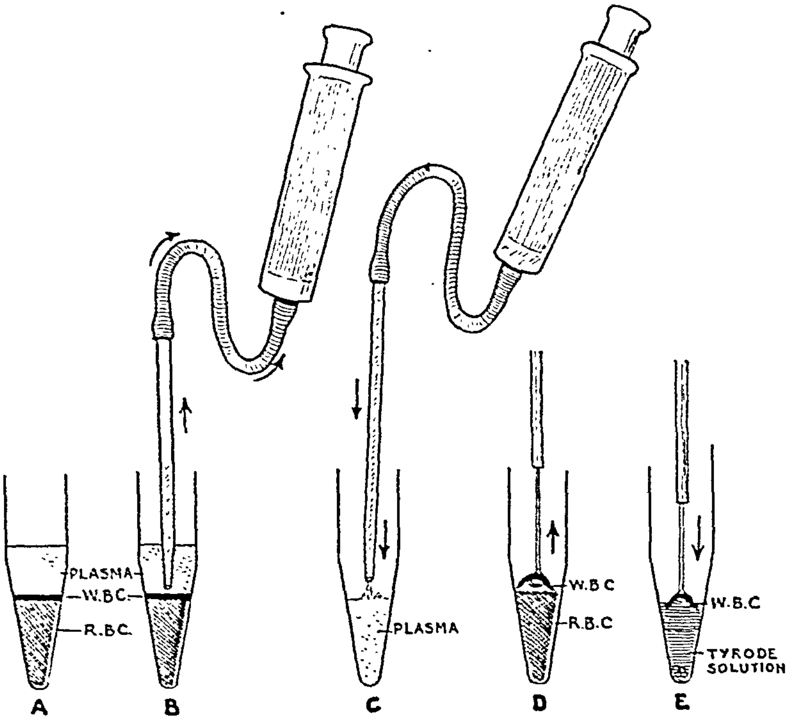

Fig. 1. A, tube, showing blood division after centrifuge; B, plasma transferred by pipette and syringe to separate tube; C, white cell film scooped from first tube, D, and transferred to another tube, E, containing Tyrode's solution and glass beads.

These resultants are sufficient for a full thickness graft up to 10 by 10 inches.

In raising the graft, allowance is made for the change in method of application. When it was the practice to suture the graft under tension, it was made to an exact pattern of the defect to be covered. It is now made 20 per cent larger than the pattern, since it is to be fitted into place without such tension.

When the graft is ready, the recipient area is given a light treatment with a sulfonamide, penicillin or gramicidin, as a precaution against the possible flare up of some dormant infection remaining after the area has been thoroughly cleansed with warm saline solution and dried with sterile gauze. Using a light camel hair brush, the area is then painted with the plasma, (Fig. 2A.) The plasma must not be spread too thickly, as the extra cells, remaining in liquid form under the graft, would tend to vitiate the adhesion and so militate against the success of the replacement.

Next, the raw surface of the graft is similarly lightly painted with the cell extract (Fig. 2B) to which some propamadine and/or sulfadiazine may be added. A sulfonamide is also given by mouth.

With the two surfaces thus treated, the graft, with its leucocytes, is imposed on the defect with its plasma. The graft is fixed at the ends of its lower line with Michel clamps. As it will have shrunk considerably (Fig. 2C), it must be stretched into place. This is best accomplished by use of a hand roller. (Fig. 2D.) Added pressure by cardboard and hand completes the procedure. No dressing or bandage is applied.

In the earlier experiments it was assumed that the graft might be allowed to overlap the skin edges of the defect. This is not good practice. There is life in the overlap on the second day, but it dies on the fourth or fifth; and in cutting it away an unsatisfactory apposition at the defect skin edges is inevitable. Stretching by roller pressure, on the contrary, banks the graft edges accurately against those of the defect, a little cardboard and hand pressure is added and the approximation is maintained sufficiently by means of a few clamps. (Fig. 2E.) These are removed before the fourth hour.

Adhesion is immediate and complete. What happens is that the prothrombin in the cell extract, when in contact with the plasma, is converted into thrombin; and the thrombin, acting upon the fibrinogin in the plasma, converts it into fibrin. A fibrin matrix is thus provided which seals the graft to its host. The fibrinogen in the plasma will, of itself, supply such a matrix and will ensure prompt adherence, as was demonstrated on one occasion when the tube containing the cell extract was dropped before the painting of the graft was completed and the contents were lost. But the plasma alone will not promote that rapid restoration of the graft that is the distinguishing factor in this method. The contribution of a fibrin matrix to the cultivation of living cells, which has always been recognized, is accelerated by the contact with the cell extract. This has been amply demonstrated. It shows the possession by the leucocytes of a function not

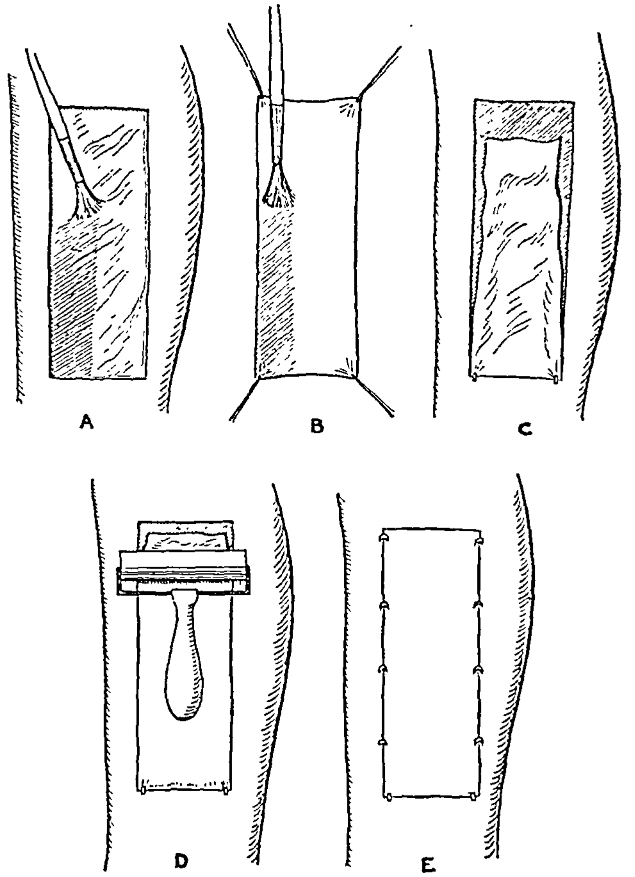

Fig. 2. A, plasma painted on recipient area; B, cell extract painted on raw surface of graft; C, graft hinged at base by Michel clamps; D, graft spread by hand roller, and adhered by cardboard and hand pressure; E, apposition retained by clamps (removed in four hours).

hitherto ascribed to them, and for which further research doubtless will account.

The process of recovery is interesting to watch. At first it should be watched from hour to hour. In a few hours the graft may become dry and should be coated with yellow sterile petroleum jelly. At the outset it is dead white. If only the plasma has been used, it is still a dirty white after four days. When both essences have been employed, the graft takes on a purplish tinge after about four hours. In rather more than twenty hours there are definite signs of life. (Overlap bled when cut on the second day.) The graft is a full purple on the second day. From then until the seventh day the purple becomes mottled with lighter tones. Patches reminiscent of sunlight exposure may appear on the fourth or fifth day, but they seem to have no deleterious effect. Pinkish tinge is present on the tenth day, and on the fourteenth this has advanced to the color of bright natural skin. From then on the progress continues until, in two months, the graft is indistinguishable from its surroundings.

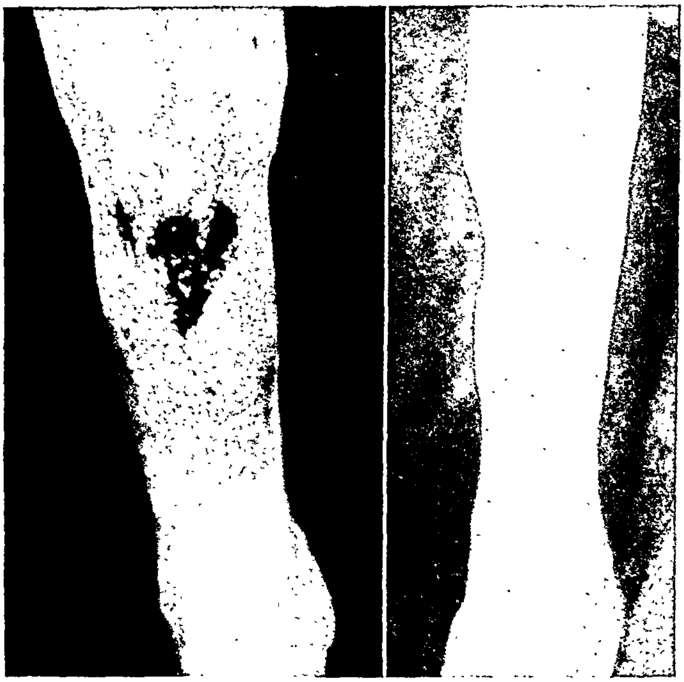

Fig. 3. A, erethistic ulcer of long standing; B, repair by full thickness skin graft, plasma fixation method.

All this can be observed in the open because the element of adjusted pressure is eliminated and there is no need for bandage. The only pressure applied is at the time the graft is imposed and then only with the hand roller, followed by such cardboard and hand pressure as may be needed to assure adherence over the whole surface. Cellophane tape gives adequate cover for the approximation lines after the clamps are removed. Precautions for protection may be necessary, especially if the graft is a large one. A hood with a cellophane window may be sufficient. If possible, the patient should be segregated in the interest of averting secondary infection. It was found advisable, in the case of a patient with a very large graft on the leg, to provide a hood under the bedclothes, to keep the legs apart by means of a rod attached at the ankles, and to restrict the scope of motion of the hands.

Now and again there may be unlooked for oozing from some small vessel of the host. If it continues and if there are evidences of infection, it is best to wait for forty-eight hours, and then take such measures as are required. This may include the indication of some spots that have not "taken." As to these it usually is best to wait and regraft.

It is not entirely new to reparative surgery that plasma can be used to advantage in the exterior treatment of wounds. The fact that plasma infusion adds to the supply of fibrinogen and, therefore, of fibrin at the area of healing, long ago suggested that it might promote healing if locally applied. I have, for example, mixed plasma with scrapings of epidermis and smeared the mixture over large and refractory wounds and have witnessed a gratifying epithelization. It may also, when mixed with the bacteriostatic compounds, be effective in the healing of infected wounds.

This compound of plasma and cell extract certainly adds to the resources of the surgical armory. It has been found to seal wounded liver tissues in which suturing leads only to bleeding, and to have been of equal effect when employed on wounds of the spleen. It is invaluable in those facial injuries in which there are flaps of torn skin whose immediate return is of high importance and in the elimination of disfiguring scar. It should make possible the closure of many not too large wounds without sutures. It offers great hope of application in many situations, as in the face and hands, with which reparative surgery is confronted from time to time.

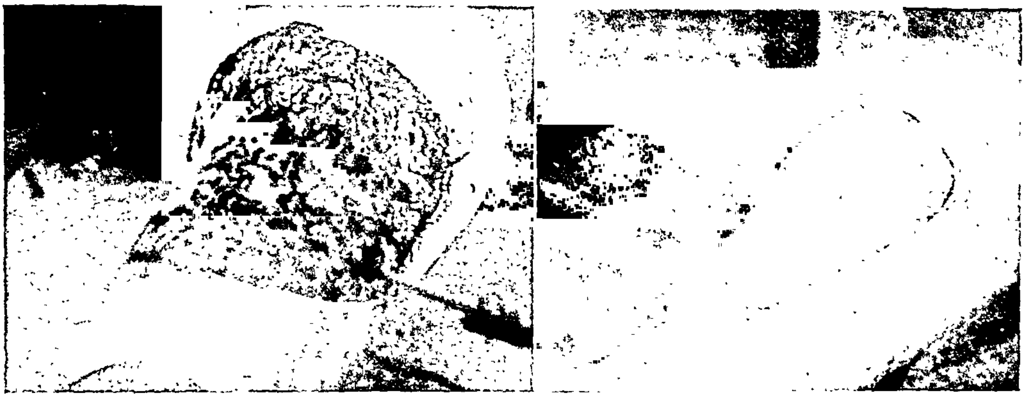
A B

Fig. 4. Same patient as in Figure 3. A, photograph of the wound after dissection; B, illustration showing how completely the graft adheres without sutures.

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SURGICAL RELIEF OF THE HYPOGLYCEMIC STATE PROBABLY DUE TO ORGANIC HYPERINSULINISM*

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REPORTS on the surgical treatment of organic hyperinsulinism have appeared in the literature with increasing frequency in the past decade. The impetus given these reports no doubt dates back to 1924, when Seale Harris[1] first proposed the concept of hypoglycemia due to endogenous hyperinsulinism. That insulin could produce hypoglycemia was already known. This idea was further accelerated by Roscoe Graham, of Toronto, who successfully cured a patient with symptoms of hyperinsulinism by removal of a pancreatic adenoma. This case was reported by Howland, Campbell and Maltby.[2] The first conclusive and indisputable evidence that islet adenomas could cause spontaneous hypoglycemia was presented by Wilder[3] and his co-workers in their now classic work.

While the number of reports has increased, hyperinsulinism still remains relatively rare. Up to 1942, Whipple,[4] whose studies have been most complete, has reported a total of only 158 cases that had been verified either by laparotomy or necropsy. At this hospital the present case is the first one demonstrated in over 39,000 admissions.

As the syndrome of hyperinsulinism became clarified it was readily evident that there were many other factors responsible for hypoglycemias. Because of this it was at once apparent that before such a diagnosis was tenable the other causes of hypoglycemia must be ruled out. The etiologic classification of hypoglycemias by Conn,[5] who has done extensive work on the subject, follows as a basis for differential diagnosis:

I. Organic—recognizable anatomic lesion
  (a) Hyperinsulinism
    1. Pancreatic island cell carcinoma
    2. Pancreatic island cell adenoma
    3. Generalized hypertrophy and hyperplasia of islands of Langerhans
  (b) Hepatic disease
    1. Ascending infectious cholangiolitis
    2. Toxic hepatitis
    3. Diffuse carcinomatosis
    4. Fatty degeneration; "fatty metamorphosis"
    5. Glycogenosis (von Gierke's disease)
  (c) Pituitary hypofunction (anterior lobe)
    1. Destructive lesions (chromophobe tumors, cysts and so on)
    2. Atrophy and degeneration (Simmonds' disease)
    3. Thyroid hypofunction (secondary to pituitary hypofunction?)
  (d) Adrenal hypofunction (cortex)
    1. Idiopathic cortical atrophy
    2. Destructive infectious granulomas
    3. Destructive neoplasms
  (e) Central nervous system lesions (lesions of brain and brain

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* From the Department of Surgery, Veterans Hospital, Portland, Oregon. Published with permission of the Medical Director, Veterans Administration, who assumes no responsibility for the opinions expressed or the conclusions drawn by the authors.

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stem; said to interfere with nervous control of blood sugar)

- II. Functional—no recognized anatomic lesion
  - (a) Hyperinsulinism (autonomic nervous system imbalance?)
  - (b) Renal glycosuria (severe degrees of low renal threshold for dextrose)
  - (c) Severe continuous muscular work
  - (d) Pregnancy and lactation

From the above it is obvious that in many instances it is difficult if not impossible to arrive at a positive preoperative diagnosis of organic hyperinsulinism. In an effort to simplify this, Whipple[6] has laid down certain criteria which, if met, justify laparotomy. These criteria or Whipple's so-called "Triad" are: (1) attacks of insulin shock coming on during fasting or in an over-fatigued state, (2) blood sugar readings of 50 mg. per cent or less, (3) relief from ingestion of glucose.

While the above criteria are definite they are probably not to be considered hard and fast. Wilder[7] declares the following similar data as prerequisites to laparotomy at the Mayo Clinic: (1) normal health and evidence of stability of the autonomic nervous system prior to first episode of hypoglycemia, (2) postabsorptive glucose tolerance curves of less than 60 mg. per cent, (3) intolerance for fasting.

In addition to the above, considerable emphasis has been placed by some on the glucose tolerance curve as being significant in diagnosis. Several have described glucose tolerance curves believed to be typical of hyperinsulinism. Among these is the so-called "paradoxic" curve noted by Smith and Seibel,[8] and Meyer with others.[9] This refers to the fact that the curve is similar to a diabetic one in contour but is produced by a state directly opposite to diabetes, viz., hyperinsulinism. The similarity in the two curves arises from the fact that the peak of the curves occurs at the end of two hours. In hyperinsulinism the values are obviously uniformly lower than in diabetes.

Womack[10] describes the "flat" type of curve first demonstrated by Rabinovitch and Fowler, as highly significant in hyperinsulinism. In this curve there are uniformly low values throughout after ingestion of the glucose. Even the peak levels at one and two hours are low.

Wilder[11] on the other hand considers the glucose tolerance data as less dependable diagnostic measures. He emphasizes that all types of curves have been obtained in verified cases. He further points out that the glucose tolerance test varies widely in different healthy individuals and even in the same subject.

The basis for the above is also borne out by the metabolic studies of Conn and Conn.[12] They have adequately demonstrated that the preliminary diet strongly influences the type of curve obtained. They point out the necessity of carrying patients on standard diets prior to the test so as to obtain greater uniformity of results.

Although most of the original surgery performed for organic hyperinsulinism was done with the hope of removing islet cell tumors it soon became apparent that these could not always be demonstrated. Under these circumstances partial pancreatectomies were performed with a view toward removing enough of the secreting islets to leave just sufficient structures for carrying on normal metabolic activities.

That these were not successful can now be readily understood in the light of our present knowledge.

The literature contains several such references. At the Mayo Clinic, Judd[13] with others cited eight cases in which the patients had been operated upon for supposed adenoma. In four of these adenoma was not demonstrated and partial pancreatectomies were carried out. However, this did not relieve the patient's symptoms. Obviously the portions of pancreas removed were too small. Similarly Finney and Finney,[14] in 1928, reported a case of pancreatectomy in which symptoms were not relieved. They estimated that about two-thirds of the pancreas was removed. In the text of their paper the actual amount of tissue removed was only 22.5 Gm. Again the amount of tissue removed was presumably insufficient to anticipate relief from the hypoglycemia.

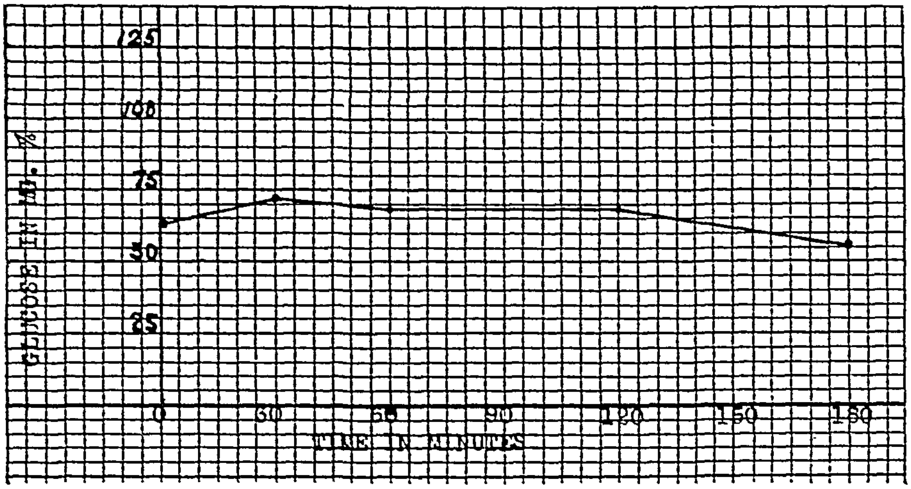

Fig. 1. Preoperative glucose tolerance curve—flat type.

On the other hand, in 1934, Evarts Graham and Hartman[15] cite a case wherein subtotal resection of the pancreas was carried out in an infant age twelve months, with apparent complete relief of symptoms. Laparotomy was performed with tumor in mind. Dr. Graham estimated that about 80 to 90 per cent of the pancreas was removed. Surprisingly enough, microscopic study carried out by Dr. J. L. O'Leary revealed a relatively normal pancreas throughout. This is in contradistinction to the oft repeated findings of islet cell hypertrophy and hyperplasia so generally reported in similar cases.

In this communication Graham remarks about the analogy between hyperinsulinism and hyperthyroidism, an idea originally advanced by Wilder.[16] Based on the improved results in thyroid surgery with more radical removal of thyroid tissue in the hyperthyroid state he points out the necessity for carrying out a similar rationale in the pancreas in which an adenoma cannot be demonstrated. With this in mind he further comments that partial pancreatectomy would not be likely to result in permanent improvement. Hence the rather unfavorable results in the aforementioned cases in which apparently too little pancreatic tissue was removed. Since Graham's case was reported other subtotal pancreatectomies have been successfully performed. Those performed up to 1935 have been concisely tabulated by Whipple and Frantz.[17] V. David,[18] in a review of the literature on pancreatectomy for hyperinsulinism reported up to 1940 this procedure had been carried out only thirty-five times. He further adds that of these subtotal resection was done only seventeen times.

Now subtotal pancreatectomy is widely accepted if an adenoma is not demonstrated. In conjunction with this, David[19] states that four-fifths of the gland should be removed. This, he further points out, should represent about 48 to 72 Gm. of tissue if good results are to be anticipated.

The following case is presented to re-emphasize that: (1) The pancreas can be approached with relative ease. (2) Good results may be expected if enough tissue is removed, even if adenoma is not demonstrated. (3) A relatively smooth postoperative course is not uncommon. (4) The physiology of the pancreas is apparently not remarkably altered. (Though the factor of fatty degeneration of the liver occurring late postoperatively must be considered.)

CASE REPORT

The patient, a white male age forty-three, a farmer, was admitted to the Veterans Hospital, Portland, Oregon, on July 1, 1943. His past history was significant in that he has a daughter, age twenty-two, with diabetes mellitus, which began when she was ten years of age. The patient also has a niece, now age sixteen, who at the age of eight had convulsions, which occurred on and off for several months. She was studied at a large hospital in Los Angeles and it was there stated that these convulsions were thought to be due to hypoglycemia. Apparently these were controlled entirely by diet, as they subsided after several months and the niece has not had any further symptoms. The only other significant element in the past history is that at the age of sixteen the patient had a severe electrical shock with a period of unconsciousness. He apparently completely recovered from this.

On admission the patient stated that he was in relatively good health until four years ago, February, 1938, when he suddenly developed sensations of weakness, giddiness and faintness. This was accompanied by marked sweating and tremor. He added that he had been doing relatively hard work that morning consisting of excessive physical labor, viz., chopping and digging on his farm. The "attack" occurred at about 11:30 A.M. This episode lasted about twenty minutes and then subsided spontaneously. He was then fairly comfortable for about ten days when he again experienced another similar episode, this time occurring about 4:30 in the afternoon. This occurred on a Sunday when he hadn't engaged in much work. He stated, however, that he had missed his lunch that day. Again the attack subsided spontaneously in about twenty minutes, before the evening meal was eaten.

Following these two episodes, he had similar ones from then on at intervals of one to two weeks with relative regularity. He continued in this way for several months when it suddenly occurred to him that with these spells, he would become quite hungry, and so he tried eating something, the first time eating bread, butter, and drinking a glass of milk. He noted that his symptoms were promptly relieved. After this when the attacks would occur, and they occurred at either 11:00 in the morning or 4:30 in the afternoon, he would eat and get relief.

About three months after the onset of his attacks, he went to see a local doctor, who, because of the marked weakness and pain in his legs told the patient that he probably had prostate trouble and treated him intermittently the next three months. His attacks continued to occur as previously, however.

He continued in this way for several more months and then saw another local physician who informed the patient that he had "adrenal insufficiency." Accordingly he was given first adrenalin, then benzedrine and sodium chloride, and shortly thereafter, thyroid extract. The patient stated that he was given adrenalin by hypo during several of his attacks and experienced almost instantaneous relief. He was then carried along on benzedrine therapy for nearly one year with indifferent effect. His attacks continued.

During this time his attacks occurred primarily in the mornings, and he stated that the benzedrine did pep him up. At the end of another year, he consulted another physician who told him that he was probably suffering from hypoglycemia. Blood sugar drawn at this time was found to be 64 mg. per cent. Following this, his physician advised him to take sugar on arising in the morning and more sugar if he should have the attacks, and also recommended that he eat candies and sweets between meals.

Under this regime, the patient seemed to get along fairly well and found that his attacks would be quickly aborted this way. As time went on, he found that it became necessary for him to take increasingly larger doses of sweets and sugars in order to stop his attacks. At this time, about the third year of his illness, the attacks occurred every morning and every afternoon daily, and the patient before long noticed that in addition to his symptoms of sweating, body tremor, and marked weakness, he began to become mentally dulled and befogged with his attacks. It was difficult for him to concentrate and he was disinterested. Still later, he noticed that this mental stupor and fogging persisted all day long, even after the attack had subsided. More recently, his inability to concentrate and a cloudy, hazy mental feeling have been predominate symptoms and constantly present.

He stated that there was a change in his attitude and personality, that he was entirely different from the way he used to be and could not do his work. He had been unable to do practically any work for the past six months.

Prior to admission, he stated that in addition to the high carbohydrate diet which he was on, he was ingesting a full pound of sugar a day in order to control his attacks. He denied having any actual convulsions. He further stated that at times if he would eat a noon meal high in protein and relatively low in carbohydrate the symptoms of the morning attack would carry over to the post lunch period. This, on the surface, would give the impression that the attack came on after meals, but actually it initiated prior to the meal and was not completely relieved by it inasmuch as there was apparently not enough carbohydrate in his diet.

Prior to admission to the hospital, he had been taking a pound of sugar divided into four doses at 5:00 A.M., 9:10 A.M., 3:00 P.M., and 9:00 P.M. Despite his confused feeling and lethargy, he was able to be up. His weight which had earlier dropped about thirty pounds was restored to his normal weight of 170 pounds after taking sugar over a six-month period.

Physical examination disclosed a well developed, sick looking, well nourished white male forty-three years of age, whose physical findings were not remarkable with the exception of a blood pressure of 96/84. The abdomen showed no masses, tenderness or rigidity. Laboratory examination: red blood cells 4,340,000, hemoglobin 85 per cent, white blood cells 8,300, differential normal. The urine was free of sugar, acetone and other pathologic components. A fasting blood sugar on July 2, 1943 was 66.6 mg. per cent with a blood urea nitrogen of 16.8 mg. per cent. Blood sugar repeated in several days was 64 mg. per cent in the fasting state. Stools showed no fat to be present. Tests for liver function: Cephalin cholesterol flocculation negative. Takata ara test negative; basal metabolism rate minus 2. Glucose tolerance on July 7th showed a flat type of curve with a fasting level of 64½ mg. per cent and a level of 55 mg. per cent after three hours. The peak level was reached in one-half hour and was 71.4 mg. per cent. (Fig. 1.) A follow-up intravenous glucose tolerance was done for diadactic reasons. Here 25 Gm. of glucose were given intravenously. The maximum level was obtained in five minutes and was 181.8 mg. per cent. In one-half hour the level was down to 74.1 mg. per cent. In one hour the level was 62.5 mg. per cent. A preoperative blood amylase determination was 66.7 units. (Normal 80 to 120 units.) Roentgen data: Gastrointestinal series normal; scout film of the abdomen essentially normal. Radiographs of the skull disclosed a normal sella turcica. Serology: Wassermann and Kahn tests negative.

Based on the above data with a relatively typical history of hypoglycemia in a patient who prior to the onset of attacks was perfectly normal, with an intolerance for fasting and a post-absorptive blood sugar as low as 55 mg. per cent, we believed that we were dealing with organic hyperinsulinism probably due to a pancreatic adenoma. Hence a laparotomy was recommended with a view toward resecting a possible adenoma of the pancreas, or a subtotal pancreatectomy if one could not be demonstrated.

On August 4, 1943, laparotomy was carried out by the senior author under spinal anesthesia (pontocaine and novocaine) supplemented by cyclopropane. At the outset an intravenous infusion of 5 per cent glucose was started. An inverse L-shaped incision with transverse section of the left rectus muscle was made in the left upper quadrant. The surgical report was essentially as follows: Following the preliminary incision the abdomen was entered and the gastrocolic omentum opened. The stomach was seen to be moderate in size. The liver was normal in size, color and texture. The gallbladder was rather small, flaccid and thin-walled. The structures in the duodenohepatic ligament felt normal. Careful palpation of the pancreas beginning laterally in the region of the spleen and progressing medialward to include the head failed to disclose any abnormalities. The pancreas appeared normal in color and texture and the size was normal. It was not abnormally fixed nor deformed. The spleen was of average size. The transverse colon and small bowel appeared normal. The omentum was voluminous. Following this general investigation the retrogastric space was further exposed and the pancreas was traced laterally and the entire pancreas well exposed from the region of the spleen to and including most of the head. The peritoneal reflection along the inferior border of the organ was incised and further palpation carried out which further demonstrated that no tumor masses were palpable. Under the circumstances the tail and body of the pancreas were then resected. During the course of this, troublesome venous bleeding occurred in the region of the spleen. This was controlled with several suture ligatures. The dissection of the tail and body was then readily continued medialward, clamping, cutting and ligating small bleeders en route with black silk. When the region of the neck of the pancreas was reached, it was well differentiated by careful dissection. Next a No. 2 chromic ligature was tied about the organ at this point and the body including the tail was resected. The stump was whipped through with numerous No. 0 silk mattress sutures. Further investigation in the region of the splenic pedicle disclosed some venous bleeding which was not readily controlled. Accordingly a 3 inch gauze pack was placed in that region and brought out at the lateral angle of the abdominal incision to control bleeding. Along with this a large empty Penrose drain was placed down to the pancreatic bed. Prior to this, 5 Gm. of sterile sulfanilamide crystals were frosted into the depths of the wound. The wound was closed in the usual manner with 2 additional Gm. of sterile sulfathiazole powder frosted into the subcutaneous wound prior to closure of the skin. The immediate postoperative condition was good, but as a general supportive measure he was given a 500 cc. blood transfusion.

The specimen of pancreas removed and submitted to Dr. F. R. Menne, of the Department of Pathology of the University of Oregon Medical School, revealed the following: Gross findings: The pancreas has the usual lobulated appearance, it is not unusually firm. The surfaces made by sectioning it reveal no marked variation in structure. Sections are selected for microscopic study. Microscopic findings: Microsections of the pancreas reveal the usual lobular arrangement. The lobular structures being demarcated by narrow bands of fibrous connective tissue. The acinar arrangement is regular. The islets of Langerhans vary considerably in size. They do not appear to be especially numerous. They possess a prominent vascularity. *The cytoplasm of the cells tends* to stay neutrophylic. The islets not infrequently present some evidence of elongation and in certain sections appear to be present in increased numbers, five such structures being seen under low power field. In still other sections the islets are quite large and apparently are highly vascular. Pathologic Diagnosis: Normal pancreas with possible hypertrophy and hyperfunctioning of the islets.

Postoperatively, the patient's course was relatively uneventful for the first two or three days. His blood sugar did not go beyond 200 mg. per cent during the first twenty-four hours and there was only very slight glycosuria. He was given 2,000 cc. of 5 per cent glucose in normal saline immediately postoperatively. Later on, as a general anti-shock measure he was given 250 cc. of human serum intravenously, and oxygen was administered by B.L.B. mask. His general condition was very good, however. At 1:30 P.M. his blood sugar was 192 mg. per cent. At 4:00 P.M. it was 200 mg. per cent, at 5:45 there was slight glycosuria and he was given ten units of regular insulin. At 10:00 P.M. the blood sugar was 114 mg. per cent and his urine showed slight glycosuria. The following morning his fasting sugar was normal—119.7 mg. per cent. Later in the day the blood sugar went to 173.9 mg. per cent as a maximum. At 4 P.M. it was 111 mg. per cent. The patient's condition remained very good. By the second or third postoperative day although his condition was good he began to vomit small amounts of clear fluid. His stomach was washed out and he felt relieved, but this continued on and off for the next few days. At no time did he have any acetone in his urine. After a few days his blood sugar stayed at normal levels continuously. (Table I.)

TABLE I
POSTOPERATIVE BLOOD SUGAR DETERMINATIONS

Day of Surgery 8-4-43	Blood Sugar Level (Mg. Per Cent)			
	8:00 A.M.	11:00 A.M.	4:00 P.M.	10:00 P.M.
8-4-43	.....	.....	200	114.9
8-5-43	119.7	173.9	111	
8-6-43	108.1	95.2		
8-7-43	95.2	125		
8-13-43	108.7			
8-18-43	118			
8-23-43	100			
9-3-43	90.9			

His glycosuria subsided completely. Although the slight vomiting was somewhat troublesome for several days it soon subsided spontaneously. On the third postoperative day the patient was able to take tea and broth and by the fifth postoperative day was on light feedings. He then continued quite comfortable for several more days. During this time the pack was removed. Shortly before the pack was completely removed the patient began to drain moderately and soon thereafter developed some left epigastric pain. A serum amylase taken at this time was 47.6 units. The possibility of a subacute pancreatitis was considered but rejected. Pain later subsided spontaneously. Following this the patient's course was relatively smooth and uneventful and the pack was completely removed. He had, however, continued to drain a moderate amount of seropurulent material. The abdomen was soft and not tender. After two-and-one-half weeks he was able to be up and about, and stated that he was perfectly comfortable and felt fine. The nervousness and jitteriness had completely gone. He was able to concentrate. His head did not feel clouded and befogged. Following surgery he had no recurrence whatever of any of his previous attacks. Follow-up laboratory studies disclosed fasting blood sugars which were normal. A glucose tolerance test done on September 8, 1943, was normal as follows:

GLUCOSE TOLERANCE TEST

	Blood Sugar	Urine Sugar	Acetone Diacetic Acid
Fasting state—before starting test	76 mg.	Neg.	Neg.
Given 100 Gm. of glucose by mouth			
½ hour after glucose	116.3 mg.	Neg.	Neg.
1 hour after glucose	125 mg.	Neg.	Neg.
2 hours after glucose	96.1 mg.	Neg.	Neg.
3 hours after glucose	73 mg.	Neg.	Neg.

A blood amylase on September 9th was seventy-five units. Serum albumin globulin 5.8 mg. per cent/2.8 mg. per cent. Cephalin cholesterol flocculation test of liver function was negative. Blood cholesterol was 154 mg. per cent. Takata ara test negative; icteric index 7. He was discharged on September 9, 1943 feeling fine. The wound was well healed with the exception of a minimal amount of drainage from the lower aspect. This was to be dressed by his local physician.

COMMENT

This case represents another instance in which a pancreatic adenoma was strongly anticipated but not found. An extensive subtotal pancreatectomy was carried out with apparently good results. The patient is markedly improved. By his own statement he feels entirely different and more normal. His fasting blood sugar is now normal as is his dextrose tolerance curve.

We believe one of the principal reasons for the result obtained here was resection of sufficient pancreatic tissue. As previously indicated too little tissue had been removed in other reports and hence no improvement resulted. This undoubtedly explains the pessimistic attitude of various surgeons toward pancreatectomy. Up to 1935, MacCaughan[2] reported that the greatest amount of tissue removed was 60 Gm. In this case 65½ Gm. of pancreas was removed. Rockey[21] states that the tendency at the Mayo Clinic at present is to remove even larger amounts of pancreas than this.

Of special interest here is the fact that the histologic character of the pancreas was not markedly abnormal. If this is so, this case would fall in the category of those wherein there is a hyperfunctioning total pancreas similar to the hyperthyroid state. That removal of even perfectly normal pancreas can result in marked improvement in these cases was referred to above in the case of Graham and Hartman.[22] It would appear that this case represents another in the same category. Review of the histology with respect to the average size of the islets in the pancreas discloses them to average 130 by 90 microns. This is compared to normal measurements of about 157 by 146 microns stated by MacCallum[23] to be average. Hence we can see that there is no real hypertrophy of the islets here. Wilder,[24] however, emphasizes the problem in determining the size of the islets and the inconstancy noted in the size of the islets in patients with no evidence of hyperinsulinism. He concludes obviously that it is not wise then to depend too much upon the size of the islets.

Of considerable interest is the matter of surgical technic. We believe that the significance of guarding against injury of the splenic vein should be emphasized. It appears that although this point has been touched on in the past by previous writers, this relatively great hazard is not adequately pointed out. McCaugham[25] states that the most important step in the operation consists of passing a temporary tape ligature about the splenic vein and artery. This serves the double purpose of providing traction if the vessels are injured and also for displaying them more prominently. He further points out that the pancreas is far more intimately attached to these vessels, especially the vein, than illustrations in most textbooks would lead one to believe.

In conjunction with surgical technic, the subject of splenectomy arises. It is debatable as to whether or not it is desirable to carry out a splenectomy as a preliminary procedure. Holman,[26] and Thomasen[27] have advocated routine removal of the spleen as being a big aid in the technic. However, in the more recent literature, this procedure has not been found to be necessary. There was a strong temptation to carry out a splenectomy here, inasmuch as the splenic vessels were injured. It was believed, however, that the additional shock of splenectomy might be too much for the patient, hence the idea was rejected, and bleeding was adequately controlled by packing.

In addition to the above it appears from the literature that the best procedure for removing the pancreas is by immobilizing the tail first and then proceeding from the lateral aspect to the mid-line. The senior author wholeheartedly believes that in carrying out such a procedure again it would be wiser and easier to transect the pancreas in the vicinity of the superior mesenteric vessels and then proceed to resect the pancreas from this point toward the tail. He is of the opinion that this would simplify the procedure considerably.

Another interesting feature that has received wide comment has been the occurrence of postoperative pancreatic fistula. This not infrequently occurs. However, contrary to popular belief, pancreatic juice as it comes from the pancreas itself is not irritating to the skin. It is only when it becomes secondarily infected that skin irritation arises and becomes a problem. This is emphasized by Luckhardt,[28] and Elman and MacCaugham.[29] In our case the patient developed moderate postoperative drainage. This was probably not a pancreatic fistula but rather a consequence of low-grade secondary infection due to the packing. It was never very troublesome and there was definitely no excoriation of the skin.

Last, while this patient has made a splendid symptomatic recovery, we are obviously not prepared to say as to how he will fare later. We, of course, refer to the possibility of fatty infiltration of the liver ensuing. There has been considerable debate as to whether or not this always occurs. As a general premise, it probably does not arise if sufficient pancreas is left so that external pancreatic secretion enters the gastrointestinal tract. This can be readily determined. Another aid in determining whether or not this will occur is the presence or absence of diabetes mellitus occurring postoperatively. It appears that if diabetes does not persist fatty infiltration will probably not develop. This is borne out in many diabetic patients who develop fatty infiltration of the liver if their diabetes is not adequately controlled. In the event that fatty infiltration should appear, it now appears that this can be controlled. Draegstedt[30] and his co-workers have isolated lipocaiac, a substance which is supposed to prevent fatty infiltration in depancreatized dogs receiving insulin. That this always accomplishes such an objective in humans has not been conclusively borne out, however. Pancreatin, that is, whole pancreatic extract seems to be an adequate substance for carrying on relatively normal pancreatic digestion in the gastrointestinal tract if the remaining pancreas is unable to do so. It is indicated if fatty diarrhea or pancreatic achylia supervenes.

In conclusion, it is believed that this case represents another instance of marked improvement of the hypoglycemic state by subtotal resection of relatively normal appearing but probably hyperfunctioning pancreatic tissue.

SUMMARY

1. A case is presented in which the hypoglycemic state probably produced by organic hyperinsulinism was apparently cured by subtotal pancreatectomy.
2. The diagnostic problems encountered in the hypoglycemic state are considered. The significance of the glucose tolerance curve is evaluated.
3. The need for "adequate" subtotal pancreatectomy is re-emphasized.
4. Some of the surgical pitfalls and postoperative problems are discussed.
5. The appearance of fatty infiltration of the liver as a possible late sequel of surgery is pointed out.

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HEMORRHOIDS

SURGICAL VERSUS INJECTION TREATMENT

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THE fundamentals of proctology are overlooked in most of our medical schools. Very few have a Department of Proctology with the result that the medical student leaves school with little or no knowledge of this subject. Further, in most teaching hospitals, there is no Department of Proctology; in these hospitals general surgery embodies proctology and no special emphasis is placed on this subject.

Much has been written on the injection treatment of hemorrhoids. The medical student, graduate physician and even laymen have heard about the non-operative or injection treatment of hemorrhoids. Our newspapers carry any advertisement as long as there is some revenue in it, as evidenced by the number of these advertisements which the laymen just cannot miss, and which tell how piles and fistulas can be cured without surgery and "while you work"; even our classified telephone directory carries the advertisements of these "sure-shots" one of which has two separate advertisements: "Get Piles Absorbed While You Work" and "Tonsils Removed While You Work." The layman should consider himself fortunate in that he is not further confused by one who might get on the radio and tell how he can cure rectal diseases without surgery; however, I may be a bit premature in this.

The subject to be discussed here is the surgical versus injection treatment of hemorrhoids. This title in itself is somewhat misleading, as it will be pointed out that there is really no controversy in the treatment of hemorrhoids. Injection therapy has its place as does surgery. Controversy does arise in those cases in which the proper therapy has not been selected in certain cases; and the mistake is general in that injection therapy is administered in those cases in which surgery is a proper treatment.

It is taken for granted that other pathological conditions are ruled out in the patient by sigmoidoscopic examination and x-ray examination, and that the diagnosis of hemorrhoids has been conclusively arrived at.

The treatment of hemorrhoids depends entirely upon the type of hemorrhoids found. Hemorrhoids can be placed under three classifications: (1) internal, (2) external, and (3) mixed or externo-internal hemorrhoids and skin tags.

Internal hemorrhoids are varicosities of one or more branches of the superior hemorrhoidal veins. They are always located above the dentate line or anorectal margin and are covered by mucous membrane. The first symptom of internal hemorrhoids is bleeding; later on, as they increase in size, they protrude on bowel movement and, upon contraction of the sphincter they will reduce themselves; however, as they get larger, they may have to be reduced manually. These hemorrhoids do not produce pain unless thrombosed or strangulated and accompanied by edema of the anal skin; they do produce a slight bit of discomfort when they protrude. Moisture may be produced by the frequent prolapse and a subsequent irritation of the anal mucosa, with a resulting deposit of mucus on the perianal skin. Upon examination these hemorrhoids, unless they are protruding, are seen through the speculum; there may be as many as eight and as few as one, but, as a rule, there are three internal hemorrhoids; one right anterior, one right posterior, and one left lateral according to the distribution of the superior hemorrhoidal veins.[1] Again, it must be emphasized that these internal hemorrhoids are situated above the anorectal margin. If these hemorrhoids are accompanied by pain, one must look for the presence of a fissure, abscess, or even a foreign body which may have become lodged in one of the anal crypts. These simple, uncomplicated hemorrhoids are the only ones that will respond successfully to the injection or non-surgical treatment. If one remembers this fact and adheres to it, he will be saved many moments of anxiety and embarrassment.

It makes very little difference as to the injection fluid, whether it be quinine and urea, or mild phenol solutions, as good results have been obtained with both. The injection should be made high, almost at the base of the hemorrhoid, and just beneath the mucosa. The amount injected can be best determined by the appearance of the mucous membrane, but one should not inject enough to produce blanching as that might produce a subsequent slough. If properly given, an injection should produce very little if any pain. Injections can be given two or three times weekly, preferably once a week, and when symptoms are relieved, the intervals between the injections can be lengthened. As a rule, ten to twelve injections should take care of the average case. The patient should be examined every six months or year to make sure recurrences do not take place. If internal hemorrhoids are strangulated and cannot be reduced, they should be operated upon at once. And again, it must be stressed that if internal hemorrhoids are complicated by other anorectal disorders, such as cryptitis, papillitis, polyp, fissure, abscess, they should be treated surgically.

External hemorrhoids can be described as those situated below the anorectal margin, and are varicosities of the inferior hemorrhoidal veins. They are covered by anal skin. These hemorrhoids may be either cutaneous or skin-tags, thrombotic or simple varicosities. Symptoms of external hemorrhoids or mixed hemorrhoids are the same as those of the internal but with the addition of the constant presence of protrusions. There is only one treatment for external hemorrhoids and that is surgical.

It is in the treatment of the mixed type or externo-internal hemorrhoids that the question of therapy arises. These hemorrhoids have their swelling on the mucocutaneous junction, the upper half of the hemorrhoid being lined by mucous membrane and the lower half by skin. From personal experience and from that of other proctologists, injection therapy in these cases will give some temporary relief; it will hold up and reduce the size of the internal part of the hemorrhoid for a very short while, and may even stop the bleeding. But the external part remains and the internal will form again. It is in these cases that recurrences will inevitably occur following injection treatment. It is in this type of case that there is some debate as to therapy injection or surgery; and it is the belief of most proctologists, and I say without fear of being contradicted, that surgery is the therapy of choice. Time and again patients have been examined and give a history of having had injection therapy, and, almost invariably, the examination reveals externo-internal hemorrhoids. Of course, it is understood, that in those cases in which surgery is contraindicated an attempt should be made to give the patient relief by injections; and even in those cases with anaesthesia on a safe level that it is today, some patients will respond more readily to surgery than they will to a prolonged series of injections. The late Norman Kilbourne,[2] in a statistical study of hemorrhoids gathered from data given him by many proctologists all over the world, reported 0.5 per cent recurrences or 148 cases following 29,425 hemorrhoidectomies, and 290 cases or 15.14 per cent in 1915 cases for injection; the author believes that these recurrences very likely took place in those cases in which attempts had been made to treat externo-internal hemorrhoids with injections.

Gabriel[3] states that as a result of increasing experience he has become extremely cautious about injecting externo-internal piles because of the recurrences and advises surgery in these cases. He further states that he used to treat, by the injection method, about 75 per cent of all patients with hemorrhoids but, at the present time, he is only treating 50 per cent and this is quite a concession on the part of Gabriel, who, primarily a surgeon and a good one, is very conservative in the treatment of anorectal ailments.

CONCLUSION

In the opinion of the author, there is no debatable question in the treatment of hemorrhoids. Good results are being obtained following injection therapy in selected cases. Good results are obtained following surgery. One must bear in mind that only the simple uncomplicated internal hemorrhoids will respond successfully to injection treatment, and that external hemorrhoids and mixed hemorrhoids will be relieved successfully by surgery only.

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Biopsy is a most important diagnostic procedure when granulomatous or adenomatous masses in the rectum of doubtful etiology are met with, and in the case of strictures which clinically might be inflammatory or due to a diffuse carcinoma.

SOME USES FOR HEAVY ANESTHETIC OILS

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EXPERIENCE at orthopedic sick-call at the Station Hospital, shows that one-fifth of the patients complain of backache. Since backache, or low back pain, are merely symptoms, it follows that proper treatment can be based only on a careful evaluation of the etiology of these pains. In order to ascertain the etiology, we have established the following routine: (1) Careful history with special attention to the location of pain, its nature, and path of radiation; (2) physical examination, observing especially the effects of the various motions of the back, and (3) *x*-ray studies, including the oblique views.

The *x*-ray studies rarely indicate the etiologic lesion. The reason for this can be plainly understood when one is reminded of the very complex ligamentous attachments of the lumbar, lumbosacral, and the sacro-iliac joints, as demonstrated in Figures 1 to 5. Diagnostic significance of observing the effect of back movement during the physical examination was described by Steindler in 1925. He made the observation that the large majority of cases of low back pain, due to mechanical causes are primarily ligament strains with demonstrable rupture of the ligament accompanied by extravasation of blood and subsequent scar formation. He studied 213 cases and made the following conclusions: "(1) Flexion increases the strain and stress in the posterior sacro-iliac ligaments, the erector spinae muscles, and their aponeuroses. (2) Extension increases strain at the lateral ligaments between the ilia and the transverse processes of the fifth lumbar vertebra. (3) In lateral bending the roots of the lumbosacral plexus are relaxed on the concave side and tensed on the convex side. (4) Increased lordosis produces tension of the sympathetic plexus and ganglia."

The author had occasion, during many years of practice as a gynecologist, to see a great many patients whose chief symptom was backache. These cases were usually thoroughly studied, including gynecologic survey, *x*-ray examination of the pelvis and the sacral region, the study of the genitourinary tract and a colonic study, including sigmoidoscopy and the barium enema. If no gynecologic disorder was discovered, the case was referred to an orthopedist for management. Too often these patients received routine treatment such as heat, massage and a sacro-iliac belt, with no improvement, or a fleeting improvement.

In the management of such cases the measures and technics commonly employed in the diagnosis and treatment of back pain were scrupulously observed. A search was made for foci of infection. Here it is interesting to point out that many a case of otherwise intractable back pain disappears almost miraculously after the extraction of an abscessed tooth. Physiotherapy measures, such as shortwave, massage and the use of the heat lamps, were employed extensively as were exercises for stretching the legs and traction. The use of these measures, combined with diligent care in searching for the exact etiology, was productive of a considerable degree of cure of pain and disorders in many cases which would otherwise have been unimproved. The problem that was particularly perplexing, however, was that of relieving severe lancinating backache which is usually localized to the upper sacro-iliac joint and cases of severe pain at the region of the coccyx. The method of injection with the usual local anesthetics was tried but proved unsatisfactory because, in most cases, the pain returned within two or three hours after the injection. The manipulation treatment described by Jostes, of Kansas, was routinely tried and many patients were relieved by this method without further treatment. However, this method requires a great amount of physical strength on the part of the physician, and is ineffective when the patient is stout or otherwise hard to manipulate.

In searching for a method which would give positive relief to a larger number of patients, I finally resorted to the injection of heavy anesthetic oils. The chemical composition is as follows:

Benzyl alcohol	4	1–6%
Procaine base	1	1–4%
Isocaine C. P. Co. (Isobythl-para-amino-benzoate)	4	1–6%
Almond oil (sweet qz. 100%)		

This method was uniformly satisfactory during my civilian practice and has been used by me in the treatment of a considerable number of cases of backache in military personnel. The immediate and lasting relief obtained is most gratifying and prompts me to detail the technic:

Particular attention is paid to the site of greatest tenderness of the back. If the pain is most severe at the attachment of the iliolumbar muscles to the ilium, 5 cc. of the anesthetic oil are injected at the site. If the pain is very diffuse over the entire sacrum 15 cc. of the oil are injected over the sacrum. With pain along the sacroiliac joint 10 cc. of the oil are injected along the ligamentous attachments of the sacroiliac joint. In severe cases with radiation to the buttocks 1 cc. of oil may be injected into each sacral foramen as in transsacral anesthesia.

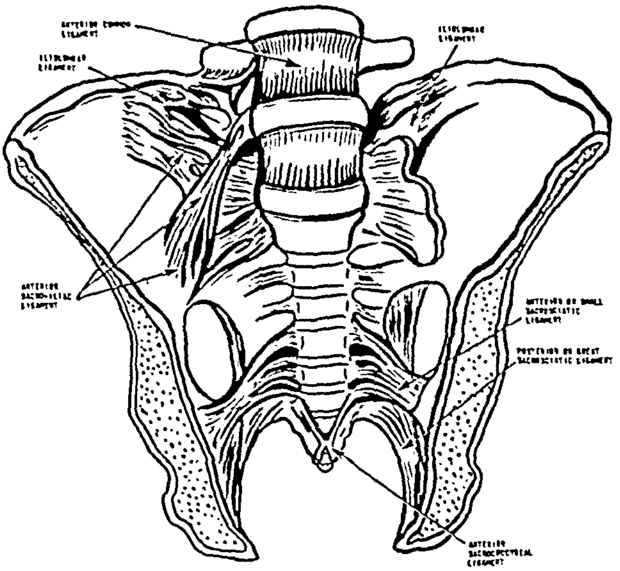
ANTERIOR COMMON LIGAMENT
ILIOLUMBAR LIGAMENT
ILIOLUMBAR LIGAMENT
ANTERIOR SACRO-ILIAC LIGAMENT
ANTERIOR OF SMALL SACROSCIATIC LIGAMENT
POSTERIOR OF GREAT SACROSCIATIC LIGAMENT
ANTERIOR SACROCOCCYGEAL LIGAMENT

Fig. 1. Anterior view of posterior half of the pelvis to demonstrate the ligaments of the sacro-iliac joint. (Redrawn from Toldt's "Atlas of Human Anatomy," vol. 1, 1928. The Macmillan Company.)

In coccydynia a small amount of procaine, 2 per cent, is injected around the coccyx and then 10 cc. of anesthetic oil is used to inject completely around the coccyx surrounding the coccyx bone. After the injection, the coccygeal muscles are massaged after Thiele. In sciatica 10 cc. of the anesthetic oil is injected in the nerve sheath with prompt relief. In very severe cases this is combined with stretching of the sciatic nerve by extending the leg at the knee and throwing the leg over the shoulder, under anesthesia. It was found that the intravenous anesthesias did not give sufficient relaxation for thorough extension of the knee and flexion of the thigh on the body of the patient. For that reason ether anesthesia is advised for this procedure.

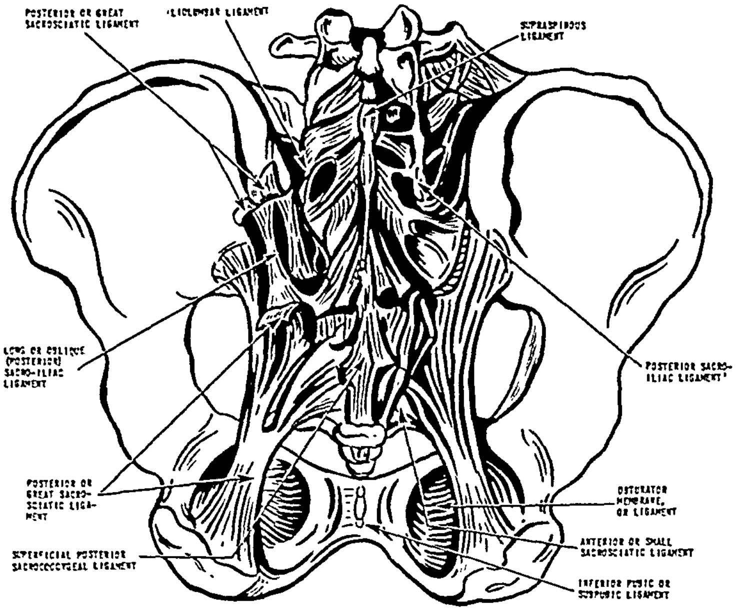
POSTERIOR OR GREAT SACROSCIATIC LIGAMENT
ILIOLUMBAR LIGAMENT
SUPRASPINOUS LIGAMENT
LONG OR OBLIQUE (POSTERIOR) SACRO-ILIAC LIGAMENT
POSTERIOR SACRO-ILIAC LIGAMENT¹
POSTERIOR OR GREAT SACRO-SCIATIC LIGAMENT
OBTURATOR MEMBRANE, OR LIGAMENT
ANTERIOR OR SMALL SACROSCIATIC LIGAMENT
SUPERFICIAL POSTERIOR SACROCOCCYGEAL LIGAMENT
INFERIOR PUBIC OR SUBPUBIC LIGAMENT

Fig. 2. Posterior view of the pelvis to show the articulations and ligaments of the pelvic girdle. (Redrawn from Toldt's "Atlas of Human Anatomy," vol. 1, 1928. The Macmillan Company.)

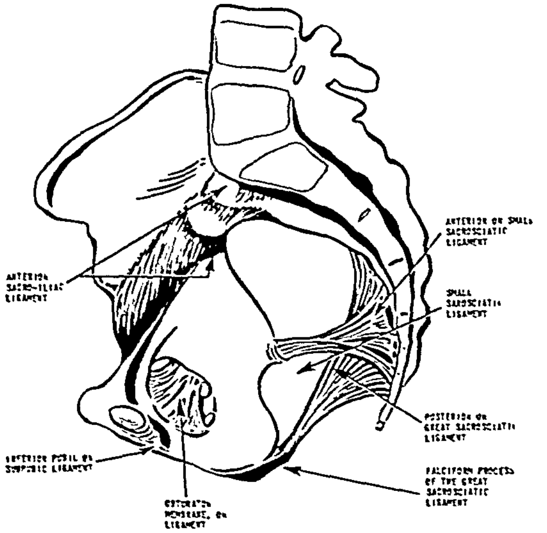
ANTERIOR SACRO-ILIAC LIGAMENT
ANTERIOR OR SMALL SACROSCIATIC LIGAMENT
SMALL SACROSCIATIC LIGAMENT
POSTERIOR OR GREAT SACROSCIATIC LIGAMENT
INFERIOR PUBIC OR SUBPUBIC LIGAMENT
OBTURATOR MEMBRANE, OR LIGAMENT
FALCIFORM PROCESS OF THE GREAT SACROSCIATIC LIGAMENT

Fig. 3.

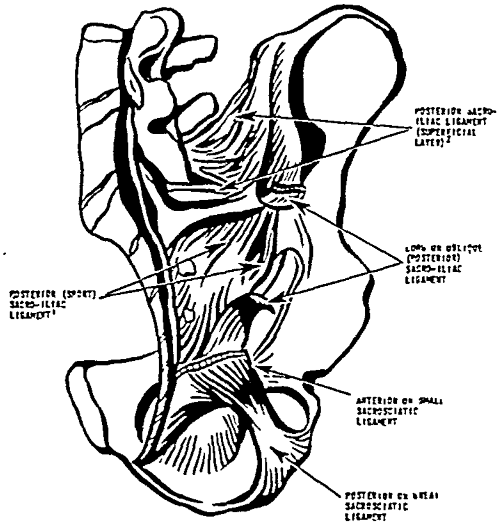
POSTERIOR SACRO-ILIAC LIGAMENT (SUPERFICIAL LAYER)²
LONG OR OBLIQUE (POSTERIOR) SACRO-ILIAC LIGAMENT
POSTERIOR (SHORT) SACRO-ILIAC LIGAMENT¹
ANTERIOR OR SMALL SACROSCIATIC LIGAMENT
POSTERIOR OR GREAT SACROSCIATIC LIGAMENT

Fig. 4.

Fig. 3.—Right half of the pelvis seen from the inner side. (Redrawn from Toldt's "Atlas of Human Anatomy," vol. 1, 1928. The Macmillan Company.)

Fig. 4. Right half of the pelvis divided in the median plane; postero-internal aspect. (Redrawn from Toldt's "Atlas of Human Anatomy," vol. 1, 1928. The Macmillan Company.)

In some of the back injuries in which the pain is diffuse and radiated through the buttocks, 4 to 6 cc. of the anesthetic oil are injected into the caudal canal. This method could also be used in anesthesia during labor instead of the continuous spinal administration of novocaine. There were no untoward effects from this injection. In fact, on four occasions I have injected 1 cc. of anesthetic oil into the spinal canal in cases of advanced carcinoma with resulting marked improvement of the severe pain for ten to twenty days. I have also injected anesthetic oils for paravertebral block in thrombophlebitis. This should prove of value in cases of peripheral vascular disease instead of repeated injections of procaine, since one injection will suffice for ten days.

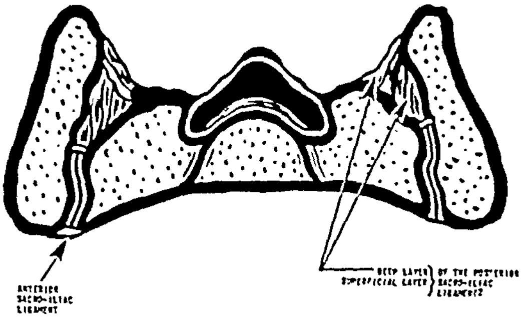
ANTERIOR SACRO-ILIAC LIGAMENT
DEEP LAYER
SUPERFICIAL LAYER
OF THE POSTERIOR SACRO-ILIAC LIGAMENTS

Fig. 5. Horizontal section through the sacro-iliac articulation. (Redrawn from Toldt's "Atlas of Human Anatomy," vol. 1, 1928. The Macmillan Company.)

It is obvious that the manipulative treatment of sacro-iliac strain offers, in the acute case, a valuable method, especially when the patient is thin and easily manipulated. However, in the stout or heavily muscled patient manipulation is extremely difficult. The injection treatment offers, therefore, a ready and easy method for relieving those patients who suffer intensely with sacro-iliac strain. At least it takes them definitely over the acute phase. In those patients who have complained of backache for several years and have lost confidence in the fact that the back is mobile or can be improved, the use of oil giving temporary relief for a period of ten days with immediate motion and exercise gives the patient a certain amount of confidence.

In cases of stiff neck, the neck muscles may be injected with 10 cc. of the anesthetic oil for the relief of severe pain if short-wave treatments do not give prompt relief. One very interesting case was that of severe pain in the interscapular area. The *x*-ray was entirely negative, but injection of heavy anesthetic oil gave complete relief and there has been no recurrence for five weeks.

In severe sprain of the ankle or strain of the shoulder or other joint, the injection of 10 cc. of anesthetic oil instead of the usual 2 per cent procaine solution gives marked relief and permits the patient to walk about without pain for ten days. The injection of procaine alone would last only a few hours, and, therefore, the oil injection is much more satisfactory.

In closing, it is the author's opinion that acute cases of painful back and sacroiliac pain which do not respond to manipulation, or in which manipulation is impractical, can very often be relieved promptly by the injection of heavy oil anesthetic locally. The method which has been described is not advocated as a panacea for the cure of all back pain, and must in all cases be complemented by a careful diagnostic study to outline the pathological condition and to rule out neurologic and other lesions; but when properly used, it will relieve a great many cases of fascial injuries, muscle and ligamentous tears and strains.

SUMMARY

The general management of cases of backache is outlined, stress being placed on an exhaustive diagnostic study. A detailed technic for injection of heavy oil anesthetics is given.

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X-RAY TREATMENT OF SINUSITIS*

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SEVERAL articles have appeared in the past few years on the value of the roentgen ray in the treatment of both acute and chronic sinusitis. All of these impress the reader with the extreme difficulty of evaluating any series of cases along this line. As Kornblum[3] has pointed out: "The extreme variability of the disease, its tendency to spontaneous remissions, and the individual response to infections in general, the complications imposed by allergy, and the marked variation in the anatomical makeup of the sinuses, introduce factors which must enter into the problem of any individual case of sinusitis." We heartily concur in this statement and have experienced considerable difficulty in evaluating our own series.

We believe that the possible psychic effect of radiation must also be strongly considered. Even as early as 1923, Osmond[4] pointed out how several patients were relieved of their sinus pain after the taking of routine radiograms of the sinus. This has been observed by several authors since then, and we have had one or two cases that responded in the same manner.

Is there a good rationale for roentgen ray treatment of the infected sinus membrane? We believe there is, but we also believe that the effect is much more dramatic in an acutely congested lining membrane than in a long-standing, chronic condition with accompanying fibrosis. This statement is not in agreement with most writers on this subject, but we believe it is warranted after observing the almost immediate relief in numerous cases of acute sinusitis. The research of Desjardins[1] has demonstrated the selective response of the various cellular elements of the body to radiation. Thus it is noted that the erythrocytes are quite resistant to radiation, whereas the leucocytes are among the most sensitive cells of the body, the lymphocytes being much more readily affected than the polymorphonuclears. These facts have been confirmed by the recent work of Kornblum.[3] Therefore, in the treatment of any inflammatory membrane (edema, leucocytic infiltration, hyperemia) the principle of the aforementioned "selective response" is brought into play.

Why are symptoms relieved by small amounts of irradiation?

In the *acute* phase of inflammation pain is usually due to stretching of the tiny nerve endings. These are under considerable tension, along with the rest of the structures of the sinus membrane, as inflammatory edema and cellular infiltration have increased the lining membrane ten to twelve times normal thickness. It might be deduced, therefore, that (1) radiation reduces the amount of cellular infiltration slightly by "selective action" on the leucocytes, and (2) radiation increases the vascular supply and drainage to the affected area. These dilated channels should serve to reduce intercellular edema by a sort of reverse osmosis, in which the fluid would re-enter the circulation. Both these factors would reduce the size of the inflamed membrane, and a decrease in tension of the nerve fibrils would accompany this reduction with resultant relief of pain.

In the *chronic* course of the disease process, improvement is probably due to the "selective action" of the *x*-rays on the leucocytes, particularly the lymphocytes, which are found in such large numbers in the typical chronic hyperplastic sinus membrane. The destruction of these lymphocytes, with resultant scarring, will definitely reduce the thickness of the epithelial lining membrane and promote more adequate drainage by relieving the membranous obstruction at the natural sinus ostium.

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In the chronic suppurative cases and those with marked polypoid degeneration the response is poor. This fact has been established by practically every authority in this field of research.

In our own series of cases we are markedly impressed by the early relief of pain, even after just one dose of 50 to 100 r to an acutely congested sinus cavity.

A statistical review of our cases is somewhat impractical because of the uncertainty of diagnosis in several cases and an insufficient follow-up in numerous others. In our type of private practice roentgenograms are not obtained in every case. Further, a goodly percentage of patients fail to return to the office once their pain has been relieved.

We believe quite strongly, however, that a high percentage of our patients with acute sinus conditions noted definite cessation of pain in four to six hours. In several instances two, three, and four treatments of 100 r were necessary for relief of symptoms, but these multiple treatments were much more predominant in the subacute and chronic stages of the disease in which pain is an insignificant factor.

As we have inferred earlier in this article, cases of acute sinusitis accompanied by pain and tenderness respond much more readily and dramatically than the chronic types of sinus inflammation. We agree with Williams and Popp[5] that better results are obtained in those cases in which therapy was instituted early in the course of the disease. Williams and Popp were among the first to stress the striking effect of roentgen therapy in acutely inflamed sinuses.

In our own series the following factors were used: 150 K.V.P., 15 M.A., 50 cm. skin target distance, and a filter of ¼ mm. copper plus 1 mm. aluminum. A machine of the General Electric "Maximar 220" type was used throughout. Treatments were given at intervals of two to six days but usually at three-day intervals. The amount of radiation given at each treatment was either 100 r or 150 r.

Of the last twenty patients who have undergone *x*-ray therapy for acute sinus disease eleven noted immediate relief of pain after one treatment, four observed relief after three treatments, while three underwent as many as five to six *x*-ray treatments before cessation of pressure symptoms. In two cases sinus puncture was performed after the first *x*-ray treatment.

Dangers from the Use of X-ray to the Sinuses. 1. The pituitary gland cannot be protected successfully as almost any sinus treatment must necessarily involve this very important structure. We do not know of any well organized research along this line, but the danger of hypophyseal damage should be kept in mind.

2. Normal physiological anatomy of the nasal mucosa may be permanently altered, although Heine has demonstrated that it requires a relatively large dose of *x*-ray to interfere with ciliary activity.

3. Some workers believe that *x*-ray therapy is to be avoided, except in the treatment of malignancy. This is because of the cumulative effect of the rays and resultant complication of treatment at some future date.

Advantages in the Use of X-ray to the Sinuses. The advantages are: (1) early relief of pain in most all cases, and (2) lack of discomfort in mode of treatment. (Many patients object to Proetz displacement and other types of intranasal treatments.)

CONCLUSIONS

1. Small doses of *x*-ray relieve pain in a high percentage of patients with an acute sinus condition.

2. A lesser number of patients with subacute and chronic sinus conditions obtain noticeable subjective improvement after *x*-ray treatment.

3. The relief of symptoms may be attributed to (1) "selective" destruction of leucocytes and (2) increased vascular supply with reduction of intracellular fluid. These two factors tend to reduce the size of the lining membrane and the nerve endings are taken "off the stretch."

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THE presence of adenoids may be inferred by the characteristic facies and proved by palpation. Chronically infected adenoids should be removed, and their removal comes within the scope of minor surgery.

ALAR SCAPULA*

AN UNUSUAL SURGICAL COMPLICATION

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MEDICAL CORPS, ARMY OF THE UNITED STATES
MEDICAL CORPS, ARMY OF THE UNITED STATES

ALAR scapula or winging of the scapula is not a common condition. It was first described by Velpeau[13] in 1825. Berger's[2] original monograph, in 1875, calls attention to the entity. We wish to present two cases that developed winging of the scapula while undergoing therapy for pilonidal cysts.

Anatomy. The serratus anterior muscle and its nerve supply are the structures involved that result in winging of scapula. The serratus anterior is a thin muscle arising by digitations from the external surfaces and upper borders of the first eight or nine ribs, and the aponeuroses covering the intervening intercostal muscles. The muscle extends backward, close to the chest wall and is inserted into the vertebral border of the scapula.

This muscle is supplied by the long thoracic nerve, which was first described by Sir Charles Bell[1] in 1827 as the external respiratory nerve. The nerve arises by three roots from the fifth, sixth, and seventh cervical nerves. The root from the seventh nerve may be absent. The roots from the fifth and sixth nerves pierce the scalenus medius muscle, while that from the seventh passes in front of the muscle. The nerve descends behind the brachial plexus and the axillary vessels. It rests on the outer surface of the serratus anterior and as it courses along the side of the thorax to the lower border of the muscle, the nerve supplies filaments to each of its digitations.

The main function of the serratus anterior muscle is to aid in fixing the scapula to the thorax when the arm is elevated, particularly anteriorly, and also to rotate the scapula in abduction and during forward elevation.

Eshner[5] best describes the muscle function in relation to the shoulder. He states that many large and powerful muscles that control the motion of the shoulder and the upper extremity are attached to the scapula, causing elevation of the acromial process and outward rotation of the lower angle. The lower angle is rotated mediad by the rhomboids. The serratus anterior moves the scapula outward, forward, and slightly upward. It rotates the scapula on its inner angle and elevates the acromion, but this motion is opposed by the elevator muscle of the angle of the scapula and the rhomboids. It maintains approximation of the scapula to the thoracic wall. The actions of the different muscles are not simple, but are complicated so that a deficiency that might result from loss of function of any one or more might be in a large measure compensated for by others.

Etiology. The etiology is an unsettled question. Some say that the condition is a result of traumatic rupture of the serratus anterior muscle at its scapular insertion. The majority of physicians believe that injury to the long thoracic nerve which supplies the serratus anterior muscle is the prime etiological factor.

Berkheiser and Shapiro[3] discuss the etiology very logically. They believe that the differentiation is difficult to ascertain clinically, because of the inaccessibility of the motor points of the serratus anterior muscle. They state that on electrical stimulation of the long thoracic nerve of Bell, in the cases in which the deformity is due to nerve injury, there will be no response. Likewise, if the muscle is completely torn, such stimulation to the nerve will not cause movement of the scapula. Thus they believe that due to the difficulty of stimulating the motor points of the serratus anterior muscle, one cannot elicit contractions of the muscle which can be interpreted by the motion of the scapula. Because of this, complete laceration of the muscle at its scapular insertion cannot be definitely ruled in or out. If the muscle is torn, they believe that there should be local tenderness, pain, swelling, and in some cases, superficial ecchymosis after a lapse of a few days, due to absorption of the hematoma. There is no description of such clinical findings in the literature. Berkheiser and Shapiro[3] also believe that if the muscle is torn, the patients would not improve with conservative management, as most of them do.

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Numerous things have been enumerated that will cause damage to the long thoracic nerve. Various types of trauma are apparently the main cause. Overpeck and Ghormley[9] found trauma the etiological agent in 82 per cent, or twenty-three out of twenty-eight cases of winged scapula reported from the Mayo Clinic. However, the types of trauma are so inconstant that many theories have been advanced to explain the mechanism of the injury.

Overpeck and Ghormley[9] state that it has been shown that the coracoid process may be forced down against the underlying first or second rib and thus injure the intervening long thoracic nerve. This theory would explain the occurrence of winged scapula from falls on the shoulder girdle. It might also explain those cases that develop when the patients carry some object on the shoulder. Ilfeld and Holder[8] reported a case of traumatic paralysis of the serratus anterior muscle seen in their service at Camp Callan, California, which resulted from trauma incidental to carrying a full knapsack.

Hauser and Martin[7] presented two cases of winged scapulae from a Station Hospital in Virginia. In the one case the injury resulted from an attempt by the soldier to lift a garbage can to his left shoulder. He noticed an immediate burning sensation over the coracoid process, radiating to the tip of the scapula. The physicians believed that in this case the contraction of the scalenus medius muscle in fixing the chest wall during the act of lifting damaged the nerve. They suggested that a contracted scalenus medius muscle may have immobilized the nerve, causing it to be stretched as the shoulder completed its arch against resistance. However, the theory advanced by Overpeck and Ghormley[9] could be used to explain the mechanism of injury in this case and the second case which Hauser and Martin[7] presented. The second case was a result of an automobile accident in which a car was overturned and thrown under a Pullman car. The patient

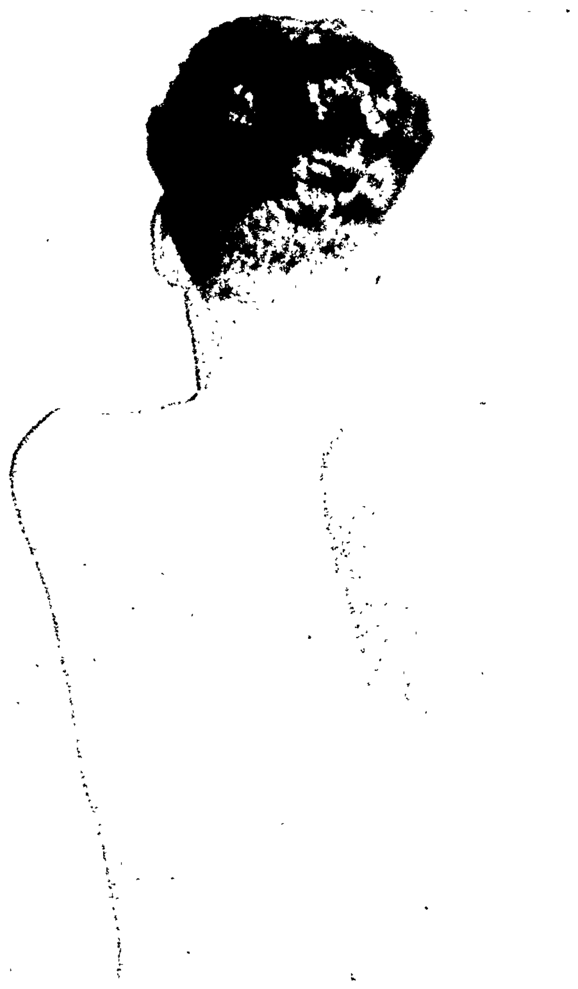

Fig. 1. Case 1. Photograph showing winging of the scapula.

was pinned for two hours in the front seat of his car, in an inverted position, with his left arm jammed against the door and most of his weight resting on his left shoulder. Hauser and Martin[7] advanced a theory for this case. They thought that perhaps, the scalenus medius muscle, contracting to support the chest, pinched the nerve long enough to cause a palsy. We have discussed the cases presented by Ilfeld and Holder,[8] and Hauser and Martin[7] at length, because it is interesting to us that they have all occurred in the armed forces and within the past year.

We also wish to present two more cases which have occurred in the armed forces.

It was Brickner[4] who cited Sehrwald[11] as stating that paralysis of the long thoracic nerve occurs by bruising of the brachial plexus between the clavicle and the scalenus medius muscle in those cases in which the arm is superabducted. Potts,[10] in 1928, indicated that injury to the long thoracic nerve occurred in conjunction with patients sleeping on the abducted arm and rolling about during sleep, so that the nerve fibers to the inferior digitations of the serratus anterior muscle were stretched.

We believe that the mechanism of injury in our cases can best be explained by these theories and preferably by the latter ones. Our first case apparently resulted from the patient lying in bed with his arms superabducted and his forearms flexed, to act as a pillow to support his head. He rested this way for two days, following the application of skin grafts to a pilonidal cyst wound, before he noticed his first symptoms. The second case developed four days after the excision of a pilonidal cyst. The patient found that he was most comfortable while resting on his abdomen. However, on the fourth day after operation, he spent the entire afternoon reading, with his head propped up by his right hand and with his right arm abducted. That evening he noticed his first symptom.

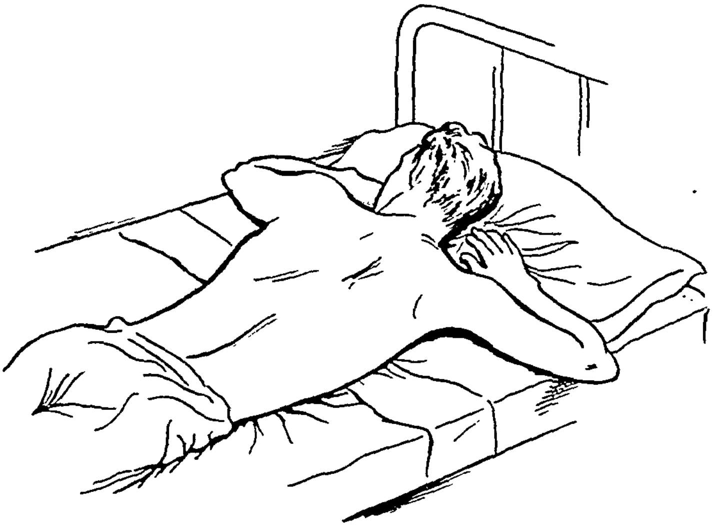

Fig. 2. Case 1. Position of patient in bed which was the probable mechanism of injury.

This condition has also been reported following wounds involving the supraspinatus region of the scapula. Various other causes of winged scapula have been mentioned, such as traction on the arms and hands during childbirth, direct injury to the nerve during operation on cervical glands, and injury sustained by a horse kicking the axilla, or a blow in this region while boxing. It has also developed after an individual misses a strong blow at a punching bag or after a golfer misses a golfball. Several authors have reported its development after an abdominal operation. The condition apparently was due to the position on the operating table.

Excluding trauma, the thoracic nerve of Bell may be involved in inflammatory or degenerative processes. It may develop following exposure to cold and wet. Febrile diseases, such as typhoid fever, influenza, diphtheria, and puerperal sepsis may be complicated by inflammation of the long thoracic nerve. The serratus anterior may be involved with other shoulder muscles in the muscular dystrophies as in anterior poliomyelitis. Hysterical paralysis has also been reported.

Symptoms. Pain was the first symptom noticed in both of our cases. It is also the one first noted in the majority of the cases reported.

The pain is usually most marked in the vicinity of the shoulder girdle. It is an agonizing ache and may radiate to the base of the neck and the back of the head, or downward over the arm and into the forearm and hand. A painful area in the axilla, especially over the midaxillary line and downward as far as the sixth or seventh rib, has been noted in some cases reported. This pain lasted two weeks in one of our cases, and three weeks in another.

The pain is usually severe enough that the inability to use the affected shoulder fully is blamed on voluntary splinting by the patient in the early stages. As the pain becomes more tolerable, the loss of motion in the shoulder becomes important to the patient. Physical examination will reveal an inability to elevate the arm above the horizontal. When this is attempted, the median border of the scapula approaches the vertebral spines. If the arms are held horizontally forward, the entire scapula protrudes like a wing on the affected side. The median border and the inferior angle of the scapula are removed from the thorax and a cavity results into which a hand can be inserted under the scapula. The arm can be elevated above the horizontal by the accessory muscles, if the upper portion of the body is inclined backward or, if the inferior angle of the scapula is rotated downward, outward, and held against the thorax. The patient is unable to apply pressure, such as that required in pushing.

Treatment. Therapy can be divided into conservative and surgical procedures. Conservative treatment consists primarily in some form of immobilization of the injured shoulder. Thomson and Miles[14] suggested the use of strychnine, muscle and nerve tonics, massage, and faradic stimulation. These men suggested a padded belt for pressure over the scapula to maintain the scapula against the thorax. Overpeck and Ghormley[9] noted good results after conservative physiotherapy and immobilization for some weeks. Follow-ups of fifteen of their patients treated conservatively indicated good results in eleven. Seven of the patients completely recovered, while four of them had persistent winging. Berkheiser and Shapiro[3] placed their patients in a plaster shoulder spica cast for approximately three months and followed this by physiotherapy. Their results in three cases were good. One patient had a

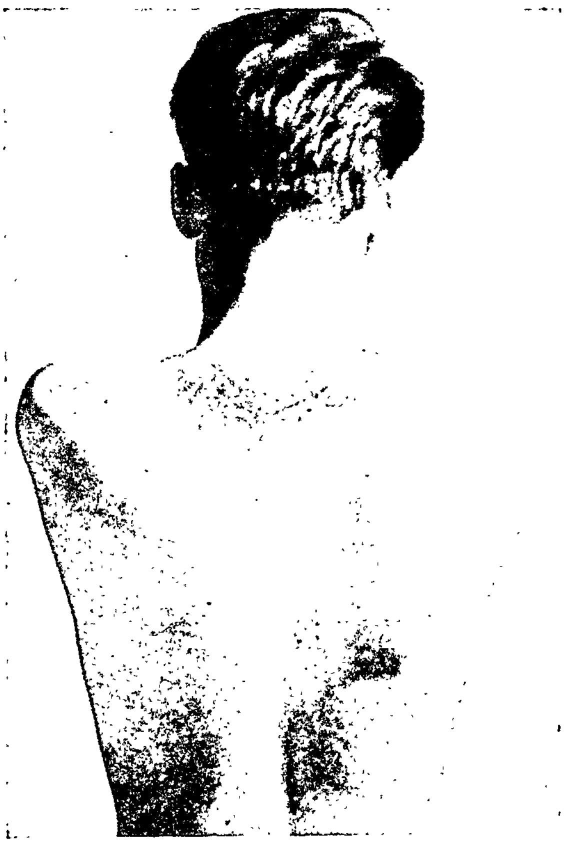
Fig. 3. Case II. Photograph showing winging of the scapula.

good result even though eighteen months of disability preceded any treatment. Hauser and Martin,[7] Ilfeld and Holder[8] all used conservative therapy with satisfactory results. One of our patients has made very satisfactory progress with only a sling for immobilization combined with physiotherapy. The second patient has made some progress but a plaster shoulder spica cast will be necessary.

Various surgical procedures have been suggested as a means of therapy, but rarely has surgery been necessary. Skillern,[12] in 1913, reported a plan for substituting one of the three adjacent subscapular nerves for the proximal end of the long thoracic nerve, but no cases in which this has been done have been reported. Hass,[6] in 1931, reported a good result after fifteen years, occurring from transplantation of the teres major muscles to the digitations of the serratus anterior muscle. Overpeck and Ghormley[9] mention the two previously suggested procedures and add a third, which is fixation of scapula to the underlying ribs. Thomson and Miles[14] consider two methods of operative intervention: (1) the transplantation of the latissimus dorsi muscle over the inferior angle of the scapula, to diminish the deformity, and (2) transplantation of the clavicular origin of the pectoralis major muscle to the serratus magnus muscle or the axillary border of the scapula.

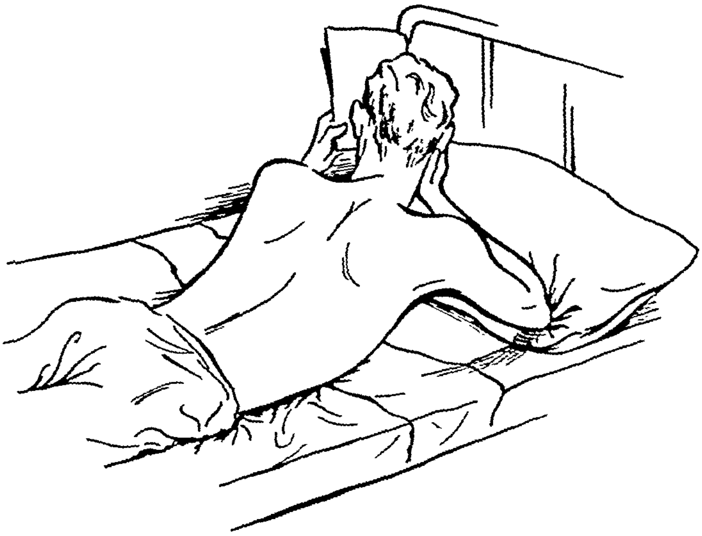

Fig. 4. Case II. Position of patient in bed which was the probable mechanism of injury.

CASE REPORTS

Case I. The patient, aged nineteen, was admitted to the Station Hospital on May 12, 1943, complaining of pain and swelling over the coccygeal area. These symptoms had occurred intermittently for three months. Two days prior to admission, the area became very painful so that hospitalization was necessary.

On May 14, 1943, a pilonidal cyst was excised. It was necessary to excise some necrotic tissue on May 24, 1943. In the following two weeks, the wound filled with granulation tissue. On June 8, 1943, skin grafts from the posterolateral aspect of the left thigh were applied to the granulating wound. Because of the grafts and the fact that it was more comfortable, the patient rested on his abdomen following this operation. He had not done this after the other surgical procedures. The patient lay in bed with his arms abducted and the forearms flexed so that his forehead rested on his hands. On June 10, 1943, or two days after the last operation, a pain was noted which extended from the right elbow up to the shoulder. This pain became progressively worse for several days and was relieved with salicylates. It then began to recede, but was present for two weeks. The pain seemed to end suddenly. The patient then noted that his right arm was weak. He was allowed out of bed on June 26, 1943, but it was not until twelve days later that a definite diagnosis was made. An orthopedic consultation on July 9, 1943, showed paresis of the serratus anterior muscle with a winged scapula. His right arm and shoulder were immobilized with a sling and he was started on physiotherapy.

In the following two months, 25 per cent of the normal power returned to his arm. The winging of the scapula has persisted and a plaster shoulder spica cast will be used.

Case II. The patient, aged 26, was admitted to the Station Hospital on May 21, 1943, complaining of a draining wound in the region of the sacrum. In 1939, a draining pilonidal cyst had first been noticed. There was intermittent drainage until May, 1942, when the cyst was excised. The wound failed to close, so in November, 1942, he was re-operated upon and a primary closure was done but was unsuccessful. The wound continued to drain and, upon the soldier's arrival at his army post, the wound had become so uncomfortable that he was hospitalized.

The pilonidal cyst area was excised on May 24, 1943. The patient returned to the ward and found that he was more comfortable resting on his abdomen, which he did for the following four days. The fourth day following operation, he spent the afternoon reading with his head propped up by his right hand with the right arm abducted. That evening the patient noticed an ache in his shoulder. The following morning the ache was still present. It was described as extending from the lower part of his neck to the upper part of the arm and included the entire shoulder. It was relieved with salicylates. The only comfortable position for the boy seemed to be for him to rest on his abdomen, with his arm lying along his side.

The ache continued for approximately three weeks and then suddenly disappeared. During this time, he noted a gradual loss of strength in the right arm.

Treatment of the pilonidal wound continued and it was not until July 11, 1943, that attention was called to the winged scapula. Treatment was begun by placing the right arm in a sling and starting physiotherapy. He has made satisfactory improvement. The strength has practically all returned to his shoulder. Three months after the original symptom of pain the winging is 90 per cent less.

SUMMARY

1. Alar scapula can follow a minimal injury.
2. Winged scapula is more likely due to injury of the long thoracic nerve than to the serratus anterior muscle.
3. Conservative treatment using some form of immobilization in conjunction with physiotherapy gives good results in a great percentage of the cases.
4. Surgical procedures are seldom indicated.

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GASTRIC ULCER, BENIGN OR MALIGNANT*

A REVIEW OF RECENT LITERATURE

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THE relationship of gastric ulcer to carcinoma has long been debatable. Histologically, it is difficult to trace the transformation of an ulcer into a carcinoma, and Mallory[1] has brought rather strong evidence to show that probably the opposite sequence of events takes place in most cases. The cancer itself ulcerates. This is particularly true in patients who have free hydrochloric acid, the acid apparently causing the center of the lesion to slough, leaving a so-called ulcerocancer. The frequency of malignant degeneration of ulcers varies from 1.9 per cent,[2] to 9.4 per cent,[3] or 71 per cent.[4] Ewing[5] aptly makes the following statement, "It is at least evident that quite specific criteria must be employed in the diagnosis of cancer following ulcer, since the conditions surrounding this process in the stomach are peculiar." Bloodgood[6] says, "Ulcer prevention and ulcer cure are part of cancer prevention and cancer cure." Walters[7] states, "In 10 per cent of the cases, gastric ulcer is malignant," and from our experience in clinically diagnosing these lesions, this seems to be correct.

In a report of superficial spreading gastric carcinoma, a type which tends to spread without invading the muscularis, Stout[8] found nine out of fifteen cases started at the margin of a peptic ulcer. These nine patients gave clinical histories of one to ten years' duration, which is suggestive of primary gastric or duodenal ulcers. Stout also reports an increasing number of ulcerated gastric carcinomas and carcinomas in peptic ulcers, all of which suggest the possibility that cases of gastric cancer are being seen earlier. In discussing the relationship of chronic ulcer to gastric carcinoma, Stout[9] says, "The only fact which emerges from this morass of uncertainties is the firmly established one that sometimes a cancer develops in the bed of a chronic ulcer which was non-cancerous at the start."

Gastritis has been studied extensively as a possible precancerous condition. Hurst[10] believes that the only common primary disease of the stomach is gastritis and that its prevention would at least partially if not wholly eliminate chronic gastric and duodenal ulcer and cancer of the stomach. Robertson[11] believes that deviation from the normal state within the gastric mucosa is a possible early beginning of gastric carcinoma. He concludes that, "The hyperplasia of the mucous glands may have some relation to the development of carcinoma." Judd[12] writes, "Carcinoma develops in a previously damaged stomach. Many years of such injury may be required before neoplastic transformation begins." Attempts at experimentally reproducing gastric carcinoma have been more successful where the environmental agents used simulate those conditions of the gastric mucosa most commonly found associated with human cancer, i.e., polyp, chronic gastritis, and ulcer.[13] Schindler[14] believes strongly that in many cases of cancer of the stomach, atrophic gastritis is a precursor, and adds that these patients should be carefully watched. Shapiro[15] is of the opinion that the frequent coexistence of atrophic gastritis and gastric carcinoma suggests an obvious relationship. Hebbel,[16] however, found the evidence of gastritis somewhat variable and could not conclude that in all cases gastritis preceded a malignant condition.

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Guiss[17] has found atrophic gastritis exceedingly common with advancing age. The slight difference in incidence of gastric atrophy between carcinoma and noncancerous stomachs, he believes, is not convincing. Konjetzny, as quoted by Hebbel,[16] emphasizes that the gastritis of ulcer is antrum-confined for the most part while that of cancer is a pangastritis.

We may conclude then that both gastric ulcer and carcinoma are nearly always associated with gastritis. It is impossible to tell in many cases which came first, but there is considerable evidence to show that gastritis frequently does precede gastric ulcer or carcinoma. From the clinical standpoint, the emphasis should be put on determining whether the gastric lesion is benign or malignant.

In many instances, it is difficult to establish the correct diagnosis by any of the present day methods.[18,19,20] There are, however, certain aspects of any case of gastric ulcer which should be thoroughly considered, and it is our purpose to enlarge on these.

Gastric symptoms should not be minimized. The initial symptoms of gastric carcinoma are slight and unreliable, and the textbook picture of a cachectic, anemic individual represents a late case. Scholz[21] stresses the fact that an unusually large percentage of patients with gastric cancer present symptoms similar to gastric ulcer and these symptoms may regress on an ulcer diet. Walters[22] in reviewing the clinical histories of 6,242 cases of cancer of the stomach at the Mayo Clinic, found that 31 per cent of the patients gave a history suggestive of ulcer. In our series, we found the following frequency of symptoms in chronic gastric ulcer and carcinoma of the stomach:

	Chronic Ulcer, Per Cent	Cancer, Per Cent
Pain in epigastrium	75	69.8
Vomiting	50	67.4
Epigastric distress	37	32.6
Weight loss	100	88.4
Melena	50	27.9

The duration of the symptoms was thirty-five months for patients with ulcer, and thirteen and nine-tenths months for those with gastric carcinoma.

Holman[18] states that the most pertinent physical finding is the presence of a palpable mass which they believe "almost always signifies malignancy." However, in the cases of a doubtful diagnosis, there is very rarely a palpable tumor. Fifty-eight per cent of our patients with gastric carcinomas had a palpable mass, but none was present in patients with gastric ulcers. This may indicate that we have been seeing our gastric carcinomas at a late stage. Other physical findings are usually of little help, except where there are obvious metastases, nodular liver, rectal shelf, Virchow's node, etc.

Allen[20] found that patients over fifty years of age, with gastric ulcers causing symptoms for less than a year, were five times as likely to have cancer as ulcer. Those with symptoms of over five years have the reverse ratio. Alvarez, in discussing Mont R. Reid's paper,[23] says, "We physicians will never get anywhere with our campaign for the early diagnosis or treatment of carcinoma of the stomach until we face the fact that a short history of indigestion in an older man is and always must be an alarming signal." The average age of our patients with gastric carcinoma was 64.1 years, and that for chronic ulcers 51.3 years. It should be stated here, however, that the patients admitted to this hospital are in the older age group and probably our figures for chronic gastric ulcer are higher than would be found in a general hospital. Of the patients seen here, 67 per cent are over fifty years of age. It should be remembered, however, that gastric carcinoma does not occur only in the older age group. Judd[39] found that approximately 7 per cent of those patients who have a gastric resection for malignant growths of the stomach are less than forty years of age.

The simplest and most common clinical test is the determination of occult blood in the stools. Any ulceration in the gastrointestinal tract may cause bleeding, and while it is not specific, it may be relevant for arriving at the correct diagnosis. We found that 80 per cent of our gastric ulcers, and 73 per cent of our gastric carcinomas had either occult blood or frank melena in the stools. The absence of occult blood excludes cancer of the gastrointestinal tract except that of the infrequent scirrhous form.

A gastric analysis which shows no acid is suggestive, but one with acid is of no aid in the differential diagnosis between ulcer and cancer. Vanzant[24] in an investigation of a large series of patients without gastric disease, found an achlorhydria in from 25 to 35 per cent, between the ages of sixty and seventy years.

Our comparison of gastric acidity in cancer of the stomach and gastric ulcer is as follows:

	Ulcer, Per Cent	Cancer, Per Cent
Hyperacidity (over 50°)	37	11.4
Acidity within normal range	50	44.3
Acidity below 25°	12	44.3

Walters[22] has been able to demonstrate a definite relationship between the value of gastric acidity and resectability in cancer of the stomach. He writes, "As the value for gastric acids increases, the resectability rate increases" and further that, "The full explanation of this relationship is not readily apparent; however, in general the more extensive lesion is apt to be associated with low acids or achlorhydria, whereas, the smaller lesion is associated more frequently with higher values for free acid." Brunschwig[25] was unable to demonstrate any relation between the size of the lesion and the acid or achlorhydria present. He has shown experimentally that there is a secretory depressant present in extracts of achlorhydric cancerous stomachs.

The most important single diagnostic procedure in gastric lesions is *x*-ray study. Lesions which are apparently benign ulcers should be watched by repeated roentgenologic examinations, and all questionable lesions, especially in elderly patients, should be explored. Babe[26] in reviewing a group of gastric ulcers, says, "The most common error was for ulcer to be mistaken for cancer." He recommends that all apparently benign tumors be submitted to operation, for the recognition of their benign character is uncertain at best.

There has been a rather marked improvement in roentgen diagnosis of gastric lesions in the past two decades. Keutner, as quoted by Babe[26] submits the following figures: prior to 1918 he found that 23.3 per cent errors were made by roentgenologists, from 1918 to 1927 there were 17.3 per cent, and from 1928 to 1937 only 8.1 per cent. Roentgenologists, however, have emphasized that it is impossible to distinguish between benign and malignant gastric ulcer in all cases.[27,28]

During the past few years, gastroscopic examination has been developed. Schindler[29] in examining ninety-five cases of gastric tumors confined by surgery, found ninety-one gastric carcinomas and four benign lesions. Of the ninety-one cases of gastric cancer, five were wrongly interpreted and five were not seen. In his group of ninety-one carcinomas, there were fifteen failures at the first *x*-ray examination. He concluded that *x*-ray and gastroscopy will yield the best results in the diagnosis of gastric tumors when used together. He stresses that the gastroscope does not take the place of *x*-ray study.

Schindler[14] has also attempted to differentiate gastric cancer on its gross appearance and determine the prognosis. He has followed Borrmann's classification[10] finding 2.9 per cent polypoid carcinoma which carry a favorable outlook, 17.6 per cent ulcers surrounded by an elevated wall, 16.3 per cent ulcers walled off only on one side, these ulcerating lesions having a fair to poor prognosis, and 63.2 per cent infiltrating growths, this last carrying a very poor prognosis. When those which resemble ulcer are added together (17.6 and 16.3, or 33.9 per cent), it corroborates the 31 per cent of gastric carcinoma having ulcer-like symptoms as reported by Walters.[22]

Most investigators, who have had experience with gastroscopy, believe that its use combined with *x*-ray study leads to more accurate and earlier diagnosis of gastric lesions. It should be remembered of gastroscopy that while it is an easy technic, interpretation is difficult and can be learned only by long study. Because of this, its usefulness is somewhat limited.

The most common site of gastric carcinoma in our series is in the prepyloric region. Review of our group of gastric carcinomas shows the locations as indicated below:

	Per Cent
Prepyloric acid	62.8
Fundus	11.7
Entire body of stomach	18.6
Cardia	6.9

The location of gastric ulceration is important, as stressed by Allen,[20] Kirklin,[31] and Holmes.[32] Allen[20] found the following approximate incidence of cancer in gastric ulcerations:

	Per Cent
Greater curvature	100
Prepyloric area	65
Anterior and posterior wall	20
Pyloric valve	10
Lesser curvature	10

Benign ulcer is found most commonly on the lesser curvature, and Ledoux-Lebard[33] showed that ulcer on the vertical part of the lesser curvature rarely becomes cancerous. Ulcers of the horizontal part of the lesser curvature (from the sulcus angularis to the pylorus), however, frequently undergo malignant degeneration. Kirklin[31] in reviewing 373 gastric lesions, found 112 (or 30 per cent) located in the prepyloric segment. Of these, ninety-three (or 83 per cent) proved to be malignant. Sampson[34] found that 75 per cent of chronic ulcers in the prepyloric inch of the stomach were malignant. It seems obvious, therefore, from these figures, that resection should be done on all lesions of the greater curvature and prepyloric area. Lesions on the lesser curvature should be watched carefully, and in the elderly age group (over fifty years) resection is the only safe course.

The size of the ulcer is only suggestive. Some believe that lesions over 2.5 cm. in diameter are malignant, but we have been impressed by the number of large gastric ulcers that we have seen, one measuring 7 by 4 cm., another 6 by 4 cm., and several over 2.5 cm. in size. Myhre[35] concludes that, contrary to the prevalent opinion, large niches may just as often represent benign lesions as cancer. It is sometimes difficult, even at the time of operation, to decide definitely as to their benign or malignant nature. The following cases bear out this point.

CASE REPORTS

Case I. C. L., Hosp. No. 4443, a seventy-five year old white male, gave a history of intermittent post-prandial abdominal pain for approximately thirty years. Pain was frequently relieved by baking soda and milk. During the year prior to entry, the pain was almost constant, and there had been a weight loss of about fifty pounds. On at least three occasions, the patient had vomited blood and passed blood by rectum. Physical examination showed an anemic, emaciated white male, obviously chronically ill. He complained of tenderness in the epigastrium on palpation, but no mass was felt. Laboratory studies showed a hemoglobin of 3.9 Gm. (or 24 per cent), with 1,380,000 red blood count. White count and urinalysis were not remarkable. Non-protein nitrogen was 64 mg. per cent, total protein 5.9 Gm. per cent. Gastrointestinal series showed a large perforating ulcer of the prepyloric region with extensive cicatricial changes in the proximal duodenum. This lesion was interpreted as benign by the radiologist. There was a marked motor delay, 75 per cent residual in the twenty-four-hour films.

After preliminary gastric lavage and repeated blood transfusions, the patient was explored. At operation a firm mass was present in the prepyloric region attached to the pancreas.

It was thought to be a benign ulcer. There were no metastases seen. Accordingly, an antecolic end-to-side oralis totalis gastric resection with isoperistaltic jejunal alignment was carried out, the ulcer floor being left on the pancreas.

The specimen showed a well demarcated ulcer measuring 5.5 by 3 by 2 cm. in size. The mucosa extended down into the ulcer, the base having been cut away. Microscopic diagnosis: Adenocarcinoma (Dr. L. V. Ackerman, Pathologist).

On the fifth postoperative day, chest films showed a right middle lobe pneumonia with associated atelectasis. The patient was bronchoscoped and put on sulfadiazine, but failed to rally, and expired on the sixth postoperative day.

Case II. J. F., a fifty-four year old white male, complained of intermittent post-prandial pain for seven years which was relieved by taking baking soda and milk until three months prior to entry. There had been occasional emesis which was untinged by blood. The appetite had been poor and there had been a weight loss of forty pounds in approximately one year. No bloody or tarry stools were noted. Physical examination showed an asthenic white male who appeared chronically ill. There was tenderness in the epigastrium, but no masses were felt. Laboratory studies showed a hemoglobin of 7.7 Gm. (or 49 per cent), with 4,680,000 red blood count. The white count and urinalysis were negative. The non-protein nitrogen was 24 mg. per cent. The total proteins were 7.7 Gm. per cent. The stools repeatedly showed occult blood. Gastrointestinal series showed an enormous perforating gastric ulcer with atrophic gastritis and associated motor delay.

After adequate preoperative preparation, the patient was explored. A huge mass on the posterior surface of the stomach, with large lymph nodes along both borders, was seen. The mass was attached to the body and tail of the pancreas, and an operative diagnosis of perforating ulcer were made. A gastric resection was performed, peeling the ulcer off the pancreas, but leaving its floor attached. The ulcer measured 7 by 4 cm. and the microscopic diagnosis was chronic ulceration with hyperplasia of lymph nodes. The postoperative course was satisfactory.

Comment. In Case I the lesion seemed benign from the time of entry until the microscopic report was given. Even at operation, it appeared benign. Lesions, such as that found in Case I, cannot be cured without resecting a considerable part of the pancreas, and in view of the fact that more distant metastases occur concomitantly, this is hardly justified. A correct diagnosis in the first case could probably have been made by opening the stomach and removing a bit of the lesion for frozen section. Holman[18] encountered this same difficulty and reported that in twenty-three of 157 patients with gastric carcinoma, it was impossible to determine at operation whether the lesion was malignant or benign. Walters[7] also mentions this point. In Case II, the history is compatible with the findings, although throughout it was similar to Case I. It demonstrates that large ulcers are not necessarily malignant.

Patients with gastric lesions usually get relief from their symptoms after resection. Jordan,[36] however, noted that patients with duodenal ulcers rather frequently continued to have some degree of epigastric distress.

The rate of healing under medical care may, at times, be helpful in the diagnosis of questionable cases. We believe that if a gastric ulcer is not healed in approximately one month, as evidenced by x-ray examination, it should be resected. Clute[37] even goes so far as to say that, "When roentgenogram suggests cancer, immediate surgery is preferable to delay and repeated roentgen examination." Steigman[38] states, "When any ulcer responds poorly to medical treatment, it is presumptive evidence that it is malignant." It must be remembered, moreover, that malignant ulcers may temporarily regress under medical treatment. It has been found that 80 per cent of patients who have gastric resection for malignant tumors and who previously received medical treatment for presumed benign ulcer, experienced temporary relief from this form of therapy.[39]

The signs and symptoms of gastric ulcer and carcinoma are similar, and only by competent roentgenologic study can early lesions be differentiated, and then not with certainty in approximately 10 per cent of the cases. It is estimated by the United States Bureau of the Census (1939) that 37,000 people die annually of cancer of the stomach. At the present time, the only hope for cure in gastric carcinoma lies in establishing the diagnosis at a time when surgical removal of the growth is possible, as metastases occur early and are frequent. Coller[40] by means of a modified Spalteholz cleaning method, demonstrated node metastases in 75 per cent of fifty-three cases, and believes that with complete examination, the incidence of involvement might have been 88 per cent. The prognostic significance of lymph node metastases is demonstrated by the following figures: cases without regional lymph node involvement had a five-year survival rate of 43.1 per cent, as compared with only 16.5 per cent in cases in which there was involvement.[41]

Every case that does not have signs of distant metastases should be explored. It must be remembered that radiologists cannot always tell if a case is operable, but as Stout[15] has said, "It is wiser to resect chronic ulcers of the stomach rather than to treat them more conservatively, because one cannot be sure that a lesion which seems clinically to be an ulcer may not in fact be a cancer." In our group of forty-three cases of cancer of the stomach seen here since the hospital opened in May, 1940, we have explored 81.4 per cent, and resected 27.9 per cent. This again is in accordance with Walters[22] who resected 25.5 per cent at the Mayo Clinic. It is too early for us to draw any conclusions on the survival rate. We have tabulated those items which we believe are of aid in differentiating gastric ulcer from ulcerocancer of the stomach.

CONCLUSIONS

In reviewing our cases and the recent literature on gastric ulcer and gastric carcinoma, we have come to the following conclusions:

1. Gastric ulcer or cancer cannot be differentiated even with special studies in about 10 per cent of all cases. At operation it may also be impossible to define the exact nature of the gastric lesion.
2. All patients over fifty years of age with a proved gastric lesion and with symptoms of less than one year's duration should be operated upon. In younger individuals, gastric ulcers which do not show satisfactory regression in approximately one month on medical treatment, should be resected. If healing does occur, repeated observation should be made at short intervals.
3. All patients with ulcers in the pyrepyloric region or on the greater curvature should be resected, because a high percentage of lesions in this location become malignant (100 per cent for lesions on the greater curvature, and 83 per cent for those in the pyrepyloric region.)
4. While large ulcers do not necessarily mean malignancy, they should be resected on that probability. Gastric cancers which simulate gastric ulcer carry a better prognosis and this alone makes surgery the treatment of choice. Also, but of lesser importance, the patient with a large gastric ulcer is likely to be very uncomfortable until it is removed.
5. Ulcerating gastric lesions in the absence of free hydrochloric acid should be immediately operated.
6. Gastric ulcers are surgical problems from the onset, and should be seen by a surgeon when first diagnosed. They should not be confused with duodenal ulcers which may frequently be adequately treated medically, and in which there is not the danger of malignant degeneration. An increasing group of investigators favor resection on all ulcerating gastric lesions.[7, 9, 16, 18, 39]
7. Operability cannot be decided by the roentgenologist.
8. The only way that we can hope to help these patients is to increase our resectability rate by earlier diagnosis, and this in turn depends upon us, as physicians, taking heed of all gastric complaints.

AIDS IN DIFFERENTIATING GASTRIC ULCER FROM ULCEROCANCER OF THE STOMACH

1. Symptoms	Essentially the same duration may be longer	Shorter duration, but of no value
2. Physical examination	No palpable mass	May be palpable mass
3. Age	Onset usually under 50 years of age	More common over 50 years but 7% of gastric resection for malignant growth are in pts. under 40
4. Special procedures		
a. Occult blood in stool	No value 80% positive	No value 73% positive
b. Gastric analysis	Acid commonly present and frequently high	Anacidity is only suggestive
c. Roentgen diagnosis	Approximately 10 per cent of ulcerating gastric lesion can not be differentiated as to benign or malignant nature	
d. Gastroscopy	Approximately 10 per cent of gastric lesions not seen or wrongly interpreted, even in experienced hands	
5. Location of ulcerating lesion		
a. Prepyloric	25 per cent	75 per cent (Sampson 34)
	35 per cent	65 per cent (Allen 20)
	17 per cent	83 per cent (Kirklin 30)
b. Greater curvature	0 per cent	100 per cent (Allen 20)
6. Size of ulcer	Large ulcer is only suggestive of malignancy	
7. Rate of regression under medical care	Of no value, may be misleading	

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THE *encapsulated subcutaneous lipoma* found on the trunk, or the trunk end of a limb, is recognized with ease by its doughy solidity and by the dimpling of the overlying skin when this is made tense by manipulation.

Case Reports

UNRUPTURED INTERSTITIAL PREGNANCY

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INTERSTITIAL pregnancy is an uncommon condition. It is rarely encountered prior to rupture. Before 1893 the only available reports are those of postmortem records. In that year Traub, and eight days later, Tait each operated for this condition. Of the cases reported in the next forty years Ash states that some 200 would withstand critical analysis, an average of five per year.

Ectopic pregnancy occurs once in three hundred pregnancies (Schumann). It comprises 1.3 per cent of all gynecologic admissions to the hospital (Wynne). Series of collected cases indicate that the interstitial variety is responsible for less than 2 per cent of all ectopic pregnancies. Approximately one in five interstitial pregnancies is unruptured at the time of operation. The greatest incidence occurs in the age period from twenty-five to thirty-five. In 1937, D'Errico had collected twenty-three cases, including one of his own, of interstitial pregnancy occurring in the stump subsequent to the removal of the extra-uterine portion of the tube.

PATHOLOGY

Interstitial pregnancy is found in that part of the Fallopian tube which lies within the uterine wall. This is the narrowest and shortest portion. Etiological factors involved are those of any ectopic pregnancy: pelvic inflammatory diseases, congenital abnormalities, operative trauma, tumors, etc. The traditional classification, theoretically attractive, divides the condition into three groups based on the site of implantation: utero-interstitial, true interstitial and tubo-interstitial. On the basis of adequately studied cases Glaesmer's grouping appears more practical: occurring in the fundus of the uterus, in the side wall and, thirdly, near the isthmus.

As the gestation progresses, imbedded as it is in the uterine wall, it is more strongly protected than when located in the thinner extra-uterine portion of the tube. As a result, rupture of the interstitial variety occurs on the average of four weeks later than in the more laterally placed types. Cases have been reported as continuing until the eighth month. Rupture is followed by severe hemorrhage and the mortality is high, being estimated at 12 per cent which is four times greater than for ectopic pregnancies in general. The prognosis depends directly upon whether operation occurs before rupture for nearly every patient operated upon before rupture has survived.

DIAGNOSIS

The diagnosis is very difficult to make before rupture and is practically impossible afterward due to the emergency nature of the case, the rigidity of the abdominal muscles and the intense pelvic tenderness. Before rupture the symptoms of ectopic pregnancy should make one suspicious: a missed or delayed period, the presence of abnormal uterine bleeding and the complaint of pelvic discomfort. The single suggestive pelvic finding is the palpation of a mass attached by a broad base to one cornua of the uterus. It may readily be confused with a normal intra-uterine pregnancy accompanied by a cornual myoma, a tubal pregnancy, a pregnancy in one horn of a bicornuate uterus or a pregnancy in a rudimentary horn.

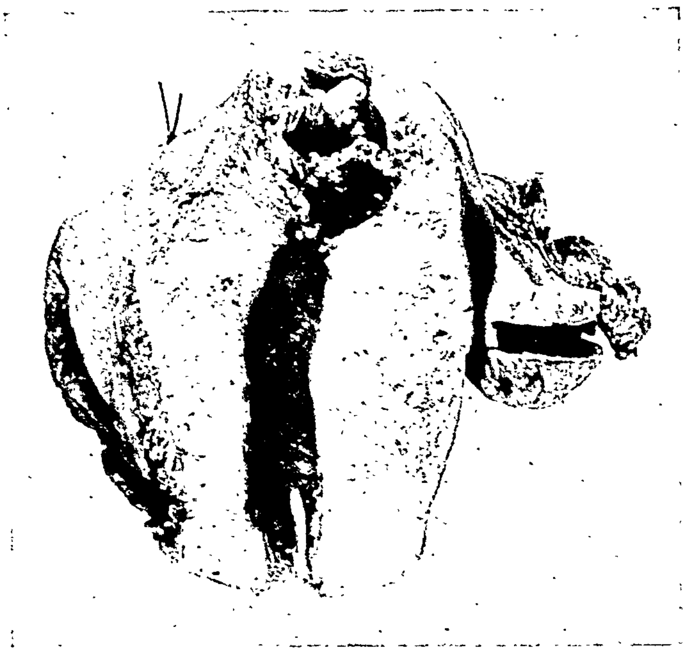

Fig. 1. View of bisected uterus with right tube and ovary attached. The gestation sac enclosing the embryo is seen in the right cornua of the uterus.

TREATMENT

The treatment varies depending upon the general condition of the patient, the size and state of the gestation, the amount and degree of coincidental pelvic disease and the wishes of the patient. Abdominal exploration is necessary. If there is evidence of rupture, the usual measures for combating acute blood loss and its accompanying shock must be undertaken. Supracervical hysterectomy is indicated in most instances. If operation occurs before rupture and particularly in the earlier weeks, excision of the sac, its contents and the surrounding muscle may be safe. However, unless one is extremely anxious to save the uterus, as in the case of a sterile couple, hysterectomy here is also the treatment of choice. It can be done safer and faster than cornual excision.

CASE REPORT

M. P., para iv, gravida vi, age thirty-eight, was first seen on October 5, 1943, complaining of abnormal uterine bleeding. Her expected July period was one week late and began on July 15th. She flowed until July 26th. On August 6th, she began to flow again and continued until August 15th. Starting August 23rd, she bled daily until October 5th. Her menses began at the age of twelve, occurred every twenty-eight days with a three day flow. There was no dysmenorrhea or leukorrhea. Urgency had recently developed. Her past history was otherwise non-contributory.

Physical examination was essentially negative except for a relaxed pelvic outlet and an unusual, soft, definitely palpable enlargement of the right horn of the uterus, palpation of which produced a distinctly uncomfortable sensation on bimanual examination. Ectopic pregnancy was diagnosed but the unusual pelvic findings created a doubt. The alternative diagnosis was a myoma involving the right horn of the uterus. Immediate surgery was urgently advised but due to an upper respiratory infection the patient insisted on deferring surgery until October 9th.

At operation, preliminary uterine currettage and examination was followed by abdominal exploration. Pathological findings were limited to the pelvis. There was no intraperitoneal bleeding. Both tubes and right ovary appeared grossly normal. The left ovary contained a hemorrhagic corpus luteum. The uterus was assymetrically enlarged to the right. Here was a cyst-like enlargement in direct continuity with the right horn, presenting on the anterosuperior aspect of the uterus. The extra-uterine portion of the tube entered the uterus inferior to this enlargement. A diagnosis of unruptured interstitial pregnancy was made and a right salpingo-oophorectomy and supracervical hysterectomy was accomplished.

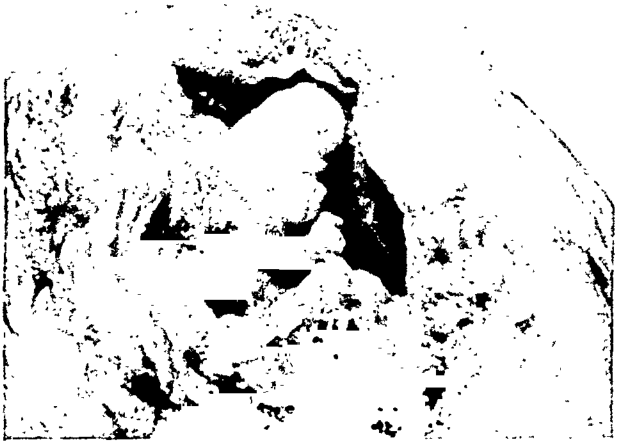

FIG. 2. Close-up view of the right cornua of the uterus.

The postoperative course was uneventful except for an exacerbation of the upper respiratory infection which was readily controlled. The patient was discharged from the hospital on October 23rd. The incision was completely healed.

The specimen consisted of uterus, right tube and ovary and tissue from the uterine currettage. The gross specimen consisted of a uterus, including the corpus and upper portion of the cervix with the right tube and ovary attached. It measured 9 by 6 by 5 cm. and weighed 128 Gm.

The fundus exhibited an irregular ovoid swelling in the right anterior superior portion. Cross section revealed this to be due to a cavity in the myometrium extending from the endometrium toward the exit of the right tube occupying the site of the uterine portion of this tube. The cavity measured 2.5 cm. in its greatest diameter. It was lined by a smooth membrane beneath which was a layer of spongy, hemorrhagic tissue. It was separated from the serosa by a thin layer of myometrium, 0.3 to 0.5 cm. in thickness. In its inferior portion the cavity extended closely to the endometrium.

The cavity contained a small embryo, which measured 1.2 cm. along its convex border and weighed 140 mg. The eye was becoming prominent and the limb buds were beginning to appear. Its estimated period of development was four to five weeks.

The lining of the uterine canal was rough and hemorrhagic as a result of previous currettage. The cervical mucosa was slightly roughened and congested. The uterine wall averaged 2.4 cm. in thickness.

The attached tube and ovary were not grossly remarkable.

A small amount of uterine currettings accompanied the above specimen. They were segments of soft, brownish-grey membranous tissue.

Microscopically, sections through the wall of the cavity in the myometrium showed a lining of placental tissue composed of chorionic villi covered by Langhans' cells and a thin layer of synctium. The villi were embedded in decidual cells and extended into the smooth muscle. In one place the placental tissue closely approached endometrium.

Sections through the lining of the uterine canal showed a thin layer of endometrium, the glands were ovoid or elongated and lined by simple columnar epithelium whose cytoplasm was pale, eosinophilic and free from vacuoles. The endometrial stroma was moderately congested but compact. Decidual reaction was not observed here.

Sections of the tube, ovary and cervix were not remarkable. The uterine currettings exhibited a structure similar to that noted in the remaining endometrium of the corpus.

Diagnosis: Ectopic pregnancy, interstitial portion of right tube, unruptured. Period of gestation four to five weeks.

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A unilateral episiotomy should not be performed as a routine procedure in normal labour but is indicated in a few cases when there appears to be some atresia of the vaginal outlet, and in certain cases of forceps delivery, e.g. in a case of occipito-posterior position when manual rotation has been performed.

DERMOID CYSTS OF THE MESENTERY

CASE REPORT

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MEDICAL CORPS, ARMY OF THE UNITED STATES

BENEVIENE,[1] a Florentine anatomist, in 1507 reported a mesenteric cyst that he found at autopsy. From Beneviene to 1850 all reports were made from autopsy material. Larkin,[2] in a review of the literature, found that from 1850 to 1880 mesenteric cysts were found at laparotomies but no recoveries noted; from 1880 to 1900 operative procedures on such cysts were successful, and from 1900 on, the condition has been definitely known, successfully treated, and occasionally diagnosed preoperatively.

Incidence. Dermoid cysts of the mesentery are the rarest of all mesenteric tumors. Cornies,[3] in a review of the literature through 1920, found that eight proved cases of mesenteric dermoids had been reported. Seven cases have been reported since 1920, one each by Sommer,[4] Piermarini,[5] Cortella,[6] Montgomery and Marest,[7] Penberthy and Brownson,[8] and two cases by Judd and Fulcher.[9]

The writer is reporting the sixteenth case which differs slightly from previous reports in that two dermoids of the mesentery were found in one patient.

Origin and Location. The theory is quite adequate to explain dermoids arising near the sites of union of the different germinal layers during development such as the orbital region, neck and coccygeal region; it does not seem adequate to explain those arising in the mesentery. The development of the mesentery is formed by the association of the splanchnic mesoderm with the infolding of the intraderm. As development proceeds the dorsal mesentery persists as seen in the adult and the ventral mesentery is occupied by the liver and heart, therefore, it is difficult to imagine cysts forming from developmental errors in the mesentery.

Dowd[10] is of the opinion that such cells might have been derived from the Wolffian body or the Mullerian tube. Ewing[11] believes that the majority of complex dermoids are imperfectly developed teratomas and favors the theory of origin from sex cells.

Guthrie[12] has described true diverticula which seem to come from the intestine. These diverticula protrude into the mesentery and become pinched off either to be absorbed or persist and form cysts.

Dermoids are located in any portion of the mesentery, from celiac axis to pelvis but are most commonly found in relation to the lower end of the ileum.

CASE REPORT

A twenty-four year old American soldier entered the hospital complaining of pains in the lower abdomen, nausea and loss of appetite. These complaints had been present for two weeks but not severe enough to consult a doctor until two days before admission when he felt as if he had a fever and the abdominal cramps were worse. There was never any vomiting, constipation, diarrhea, or urinary disturbances, and no history of similar illness. The patient had lost six pounds in weight since his illness because of poor appetite.

Physical examination showed a well developed and well nourished male in some apparent abdominal discomfort. His temperature was 100.5°F, the pulse 100 and the respirations 20. The blood pressure was 110 systolic, 70 diastolic. Positive findings were limited to the abdomen and rectal palpation.

In the abdomen there was a tender, fixed mass which appeared to fill the right lower quadrant and extended over just to the left of the umbilicus. A mass high on the right was felt outside the rectum. The patient's condition did not appear to be one that needed immediate surgical intervention, but careful observance of the apparent walled off localized appendiceal abscess. The author being a believer of the school that does not recommend immediate surgery of a well walled off appendiceal abscess as long as the patient's condition is satisfactory (which is judged by the general appearance, temperature, pulse, respiration, blood count and other abdominal findings), the patient was put on chemotherapy and oral diet was restricted.

Examination of the blood on admission revealed a red cell count of 4,840,000, a hemoglobin of 95 per cent, and a white cell count 20,000, with 86 per cent polymorphonuclears. The urinalysis was negative. Six hours after admission his condition was satisfactory; the temperature 99.5°F., pulse 90, respirations 20, a white cell count of 12,500 with 79 per cent polymorphonuclears. Forty-eight hours after admission the temperature, pulse, and respirations were normal. The white cell count had dropped to 9,900 with 71 per cent polymorphonuclears. The patient appeared to be improving and chemotherapy and intravenous feedings were continued. Six days following admission in examining the abdomen the mass appeared changed in position and was ballotable. A flat plate of the abdomen showed a large, sharply outlined, rounded, oblong mass, containing numerous small areas of calcification. A lateral film of the abdomen was taken for localization and exclusion of bony attachment. The patient's temperature had been normal for ten days and with these films and progress of patient the mass did not appear to be appendiceal in origin. The patient was up and about in the surgical wards and apparently getting along nicely except the anorexia and abdominal masses persisted. Further *x*-ray studies were made as shown in Figures 1, 2, and 3.

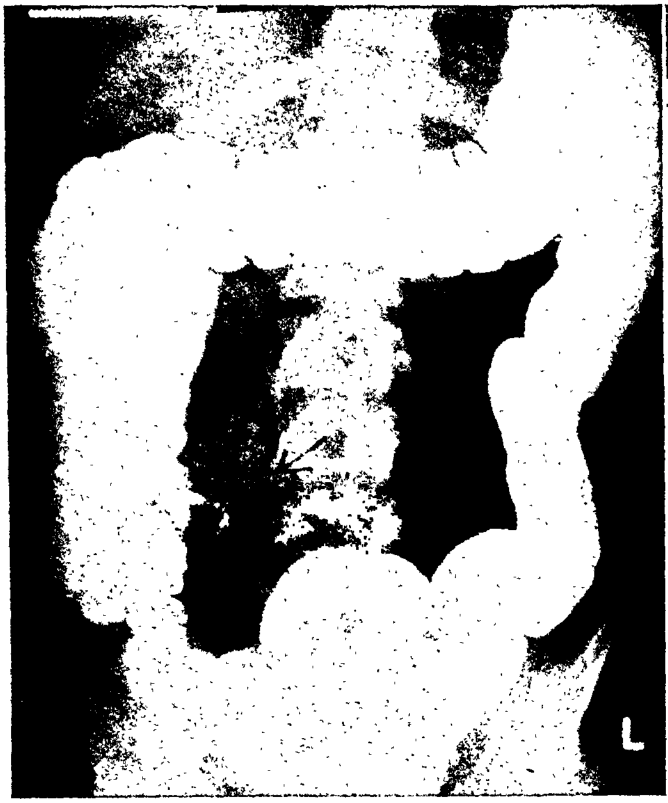

Fig. 1. Barium enema showing location of masses in relation to cecum.

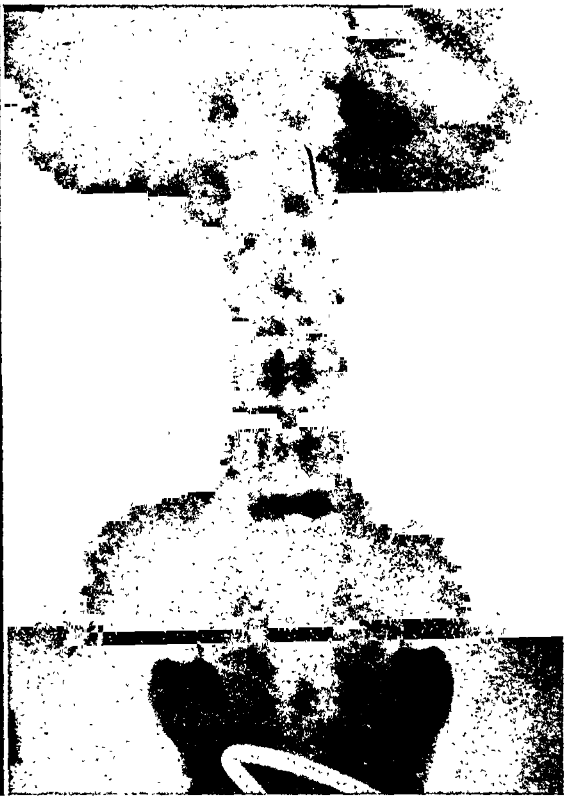

Fig. 2. Flat plate of pelvis and outline of masses just before injection of dye for cystogram Figure 3.

From the *x*-ray studies a preoperative impression of dermoid cyst was made and the patient prepared for operation.

Under gas, oxygen, and ether anesthesia the abdomen was opened through a right midparamedian incision. Exploration of the peritoneal cavity revealed two fixed oblong cystic (solid) masses, one measuring 2 by 4 inches and the other 2 by 3 inches, situated in the mesentery of the distal two feet of the ileum. They were approximately three inches apart. The smaller mass contained adherent omentum and showed signs of recent perforation with spilling of contents. The small mass was enucleated with moderate difficulty. Care was taken to avoid major blood vessels and the blood supply to the intestines did not appear impaired. The mesentery was then closed with continuous atraumatic chromic catgut No. 00 following ligation of all small bleeding vessels. The same procedure was carried out for the larger mass with more difficulty and in the process a small perforation was made during sharp dissection but was promptly closed with a purse-string suture. Five Gm. of sulfanilamide powder was placed intraperitoneally and the abdomen closed without drainage.

FIG. 3. Cystogram showing elevation and movability of masses to a higher level as compared with flat plate of pelvis in Figure 2.

The pathological report revealed:

"Gross: Two tumor masses, both similar. One kidney-shaped and lobulated measuring 9.5 by 5.8 by 4.5 cm. and having a fibrous capsule with many small vessels and ecchymotic spots giving it a slightly mosaic appearance. On section the capsule measures 0.3 cm. in thickness and the entire mass is filled with a light clay-colored, yellow-gray caseous material more like a paste. On removing the caseous material the inner surface presents slightly elevated ridges and points some of which are calcified and being as large as 1 to 2 cm. The other tumor mass measures 8.5 by 5.4 by 4.8 cm. and has attached a fibro-fatty tissue (apparently omentum) which measures 12.0 cm. in diameter. This tumor is smooth surfaced and egg-shaped and likewise presents the same features as the other.

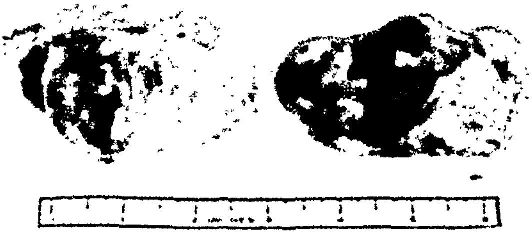

FIG. 4. Gross specimens intact following enucleation from mesentery.

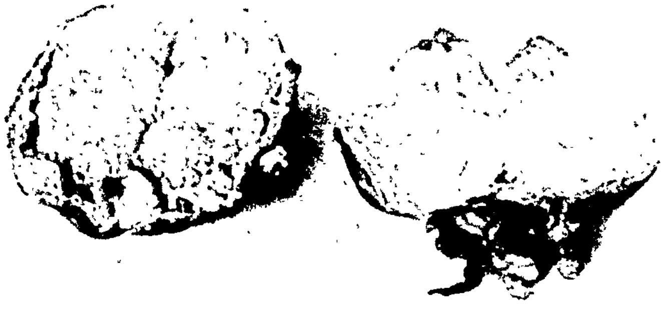

FIG. 5. Sagittal sections of gross specimens.

"Microscopic: Sections confirm gross diagnosis; the wall is lined by a flattened epithelium which is supported by a fibrous laminated stroma. Within portions of this stroma are rather large amounts of bony structure characterized by definite lacunae, trabeculae and Haversian System.

"Note: At one point of a papillary like projection appears to be the excretory source. No hair found in any portion.

"Diagnosis: Dermoid cysts of the mesentery."

Following operation the patient made an uneventful recovery, the temperature never ranging above 99.8°F. Intravenous fluids were given in the first twenty-four hours postoperatively and sulfadiazine orally for seventy-two hours.

The symptoms of dermoid cysts of the mesentery are those of complications such as obstruction (kinks, volvulus, intussusception) peritonitis, hemorrhage, (sloughing of blood vessel) and torsion. In the case presented, a localized peritonitis was the reason for admission and the movability of the mass later (six days after admission) suggested a thorough investigation as the picture was not that of appendiceal abscess which was the initial impression. A preoperative impression of mesenteric cysts was obtained by the process of elimination and the radio-opaque material in the cysts suggested the cysts being dermoids. Some may wonder why a cystogram was indicated after taking anteroposterior and lateral views of the abdomen, gastrointestinal series and barium enema.

The roentgenologist encountered a very unusual experience while palpating the abdomen during the barium enema in that the patient had a very copious ejaculation without an erection, and the fluid was greater in amount than normal. This experience warranted a cystogram to exclude a possible encysted diverticula of the bladder. Views of the gross specimens are shown in Figures 4 and 5.

SUMMARY AND CONCLUSION

1. Dermoid cysts of the mesentery are rare, the case presented being the sixteenth to be reported in the literature.
2. Expectant treatment of a localized, walled off peritonitis and later *x*-ray studies enabled a preoperative impression of dermoid cysts of the mesentery.
3. The cysts were located in the distal two feet of the ileum.
4. The origin of dermoid cysts of the mesentery remains undetermined.
5. Symptoms exhibited in this case were those of complication (peritonitis).
6. Treatment rendered was enucleation of cysts without intestinal resection.

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GANGLION CELL TUMORS OF THE NECK*

TWO CASE REPORTS

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THE infrequency of ganglion cell tumors in general and of those occurring in the neck in particular is indicated by the reviews of McFarland and Sappington[1] and of Shumacker and Lawrence.[2] The former listed seventeen reported cases of cervical ganglioneuromas and added one of their own. However, the latter tabulated only fourteen cases including one of their own. They excluded several cases listed by McFarland and Sappington[1] because the tumors apparently arose in the mediastinum or appeared to be a neuroblastoma, sympathicoblastoma, or of a mixed type. The rarity of cervical ganglion cell tumors prompts the presentation of the following two cases:

CASE REPORTS

CASE I. A white girl, five and one-half years old, was admitted to the hospital because of a firm, movable tumor below the angle of the left jaw. It was first noticed about eight months previously and gradually enlarged to a diameter of approximately 4 cm. The tumor was excised without difficulty from beneath the left sternocleidomastoid muscle. The postoperative course was uneventful except for some impairment of motion of the left eyelid, of about six months' duration. Other features of Horner's syndrome were absent. She has remained well and without evidence of recurrence or metastasis during a three-year period of observation.

The gross specimen was an encapsulated, moderately firm, rubbery mass measuring 2.5 by 3.5 by 4 cm. The tissue cut with moderate ease, revealing a slightly bulging, pink-yellow, somewhat whorled surface.

Microscopic examination of hematoxylin and eosin preparations revealed that the bulk of the tumor was composed of a rather compact, fibrillar tissue, arranged in irregular and intersecting bundles, which had the appearance of nerve tissue. Ganglion cells were scattered here and there through this tissue singly or in small clumps. Near the center of the tumor there were several areas of somewhat loose fibrillar tissue in which considerable numbers of ganglion cells as well as other smaller cells were enmeshed. (Fig. 1.) The ganglion cells were large and irregular, with fairly homogeneous, pink cytoplasm and eccentrically placed, large, round or oval nuclei containing a prominent chromatin network and nucleolus. A number of other cells were about the size of lymphocytes, and had very scant, pink cytoplasm with rounder, dark nuclei. Cells of all intermediate stages were also present. Mitotic figures were not found, but an occasional ganglion cell had two nuclei. Some of the larger cells had vacuolated cytoplasm and no nuclei.

Masson's trichrome stain showed small to moderate amounts of connective tissue in the compact areas, but none in the loosely arranged tissue containing more numerous ganglion cells. Bodian's protargol stain[3] demonstrated that most of the fibers in the compact areas and all of them in the loosely arranged tissue were nerve fibers.

The diagnosis was ganglioneuroma.

CASE II. A white man, eighty-eight years old, noticed a tumor of the right side of his neck for about one year. It had enlarged gradually during this period until it was about 3 by 4 by 5 cm. At that time a roentgenogram of the chest revealed a number of large and small round areas of increased density in both lungs, typical of metastases. A biopsy of the neck tumor was taken. Roentgen therapy was given, but the patient died at home one month later. An autopsy was not performed.

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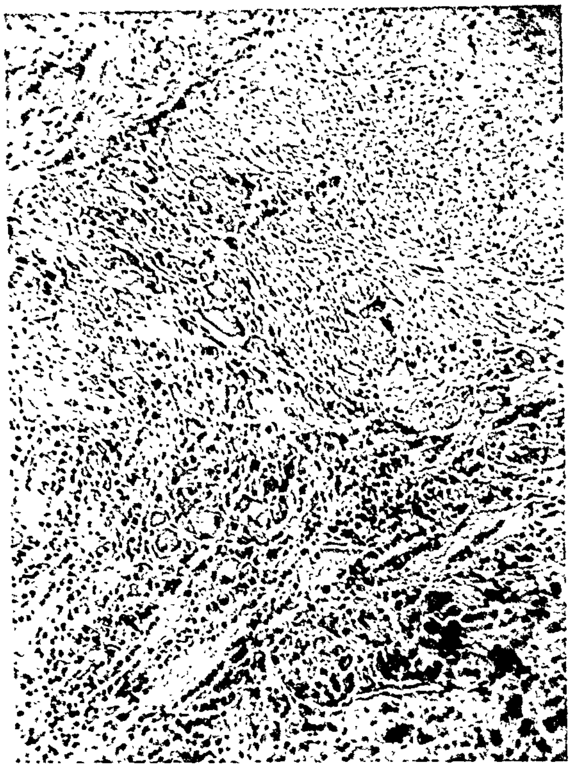

Fig. 1. Microphotograph of tumor from Case I, showing ganglion cells and nerve fibers; hematoxylin and eosin; × 80.

The tissue from the biopsy consisted of a very soft, pink, structureless mass about 0.5 cm. in diameter. Microscopic examination of hematoxylin and eosin preparations revealed a highly cellular tissue. The cells were irregularly disposed in a loose fibrillar matrix and were not interconnected. They were quite variable in size and shape, and many appeared to have interlacing processes. (Fig. 2.) The cytoplasm of the large cells was usually pink, although it was frequently vacuolated and sometimes smudged or frayed at the edges. The nuclei of these cells were usually large and oval or somewhat irregular. Some of them were very hyperchromatic; others were vacuolated; and occasionally they had distinct chromatin network and a prominent nucleolus. There were also many small cells with scant cytoplasm and round or somewhat irregular dark nuclei. Many of the cells represented transitions between the large and the small cells. Occasional cells were noted with two nuclei and some had no nucleus. Mitotic figures were infrequent. A few small blood vessels were scattered here and there through the tissue.

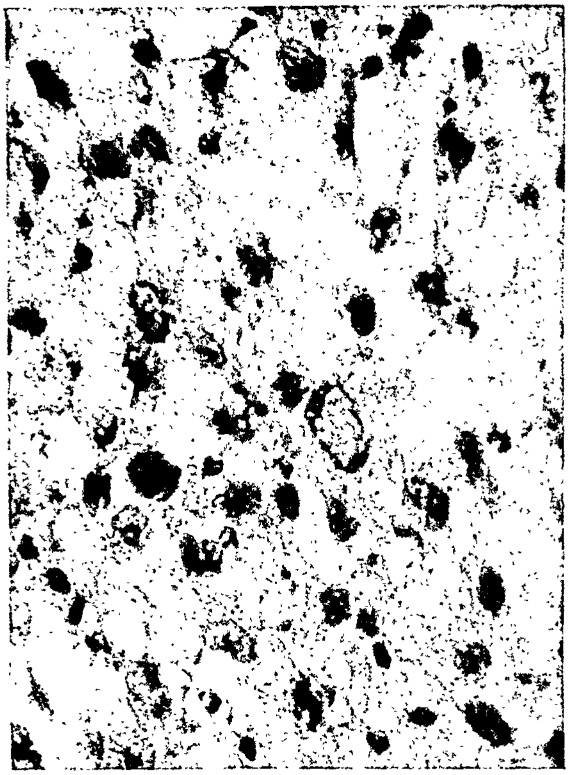

Fig. 2. Microphotograph of tumor from Case II, showing marked variability in size and shape of the cells. Note the processes of some of them; hematoxylin and eosin; × 660.

Van Gieson's stain and Masson's trichrome stain showed no collagen between the cells and there was only a scant amount of connective tissue, which was located around the scattered small blood vessels. Mallory's phosphotungstic acid hematoxylin stain revealed no neuroglial fibrils. Bodian's protargol stain[3] demonstrated that the fibrils of the matrix were neurofibrils.

The diagnosis was ganglioneuroblastoma.

COMMENT

The most generally accepted theory for the origin of ganglion cell tumors is that they arise by multiplication of embryonal neurocytes which continue to multiply and differentiate through the various stages up to adult ganglion cells. Thus tumors of this type may often be composed of varying proportions of cells representing the different stages of embryonal development. Similar to neoplasms of other tissues, it appears that the more highly differentiated the ganglion cell tumors are the more likely they are to be benign. The terminology used in diagnosing these tumors is not well defined, however. Shumacker and Lawrence[2] considered that the term, ganglioneuroma, should be applied exclusively to tumors showing ganglion cells and nerve fibers without sympathicoblasts or neuroblasts. On the other hand, a number of cases that have been reported as ganglioneuroma apparently contained many poorly differentiated cells, as well as mature ganglion cells. In fact, McFarland and Sappington[1] refer to a report by Gibberd describing as ganglioneuromas two tumors in which no ganglion cells were found. Even Shumacker and Lawrence[2] mentioned in the description of their own case that a few small aggregations of small round cells with a very thin rim of pale eosinophilic cytoplasm and round, deeply staining basophilic nuclei were scattered diffusely throughout the sections. These cells surely would not be considered mature ganglion cells. Thus, while it may be advisable to reserve the term ganglioneuroma for tumors composed principally of mature ganglion cells and nerve fibers, it seems unnecessary to insist that all of the ganglion cells be mature.

The tumor from the first patient in this report had the typical appearance of a benign ganglioneuroma similar to the cases included by Shumacker and Lawrence.[2] While it contained some apparently immature cells, it has followed a benign clinical course. The biopsy from the second patient, however, showed predominantly poorly differentiated cells as well as a number of cells more nearly approaching the appearance of adult ganglion cells. While the tissue examined was somewhat degenerated and other portions of the tumor and its metastases were not obtained, the term ganglioneuroblastoma describes its partially differentiated microscopic structure and indicates its malignant nature.

SUMMARY

Two cases of ganglion cell tumors of the neck are reported. One patient was a white girl, five and one-half years old, with a well differentiated tumor, a ganglioneuroma. She has remained well for three years since its removal. The other patient was a white man, eighty-eight years old, with a partially differentiated tumor, a ganglioneuroblastoma. This tumor was associated with roentgenologic evidence of pulmonary metastases and a malignant clinical course.

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CONGENITAL ATRESIA OF THE ILEUM, SPONTANEOUS PERFORATION AND MULTIPLE INTUSSUSCEPTION*

TWO CASE REPORTS

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ABDOMINAL surgery of infancy and childhood has received accentuated attention from the general surgeon in recent years. Some surgeons have stressed this branch of surgery as a distinct specialty. It cannot be denied that extreme delicacy is necessary in pediatric surgery, even as the cases encountered present most interesting features. In the course of our residency in pediatric surgery, we have seen two unusual cases which we are presenting herewith.

CASE REPORTS

CASE I. The patient was a premature infant (eight months) born to a primiparous mother. The mother had hypertension and polyhydramnios. At the time of birth the child cried loudly and breathed spontaneously. The birth weight was 4 pounds, 4 ounces. The general appearance of the baby apparently was satisfactory. On the first postpartum day marked abdominal distention occurred. A Levine tube attached to a Wangensteen suction apparatus plus a rectal tube failed to relieve the distention. At this time the temperature was 102°F. and the infant regurgitated yellow green fluid. During the twenty-four hours following birth no stool was passed. Enemas gave no results. An emergency flat plate of the abdomen was taken at this time. (Fig. 1.)

Surgical consultation was requested. The infant was subjected to surgery thirty-six hours following birth. The abdominal cavity was entered via a right paramedian incision. When the peritoneal cavity was entered many organized adhesions were found between the parietal and visceral layers. The entire small intestine was found to be matted together by an organized fibrinous plastic exudate. The ileum was bound down forming the mass visualized by *x*-ray. This mass measured 3½ by 2½ inches and was found in the right mid-abdomen. At this point the ileum was perforated for its entire diameter. Meconium fluid seeped through this opening. The intestinal perforation occurred five inches from the ileocecal valve. Three and a half inches from the ileocecal junction was found a non-perforated membrane completely occluding the lumen of the ileum. The small intestine was distended to the area of the mass and the per-

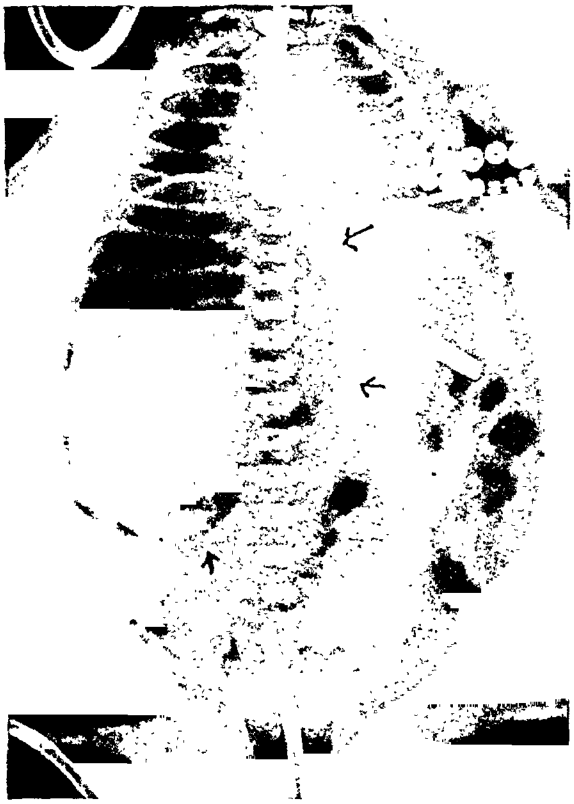

FIG. 1. Flat plate of abdomen demonstrating tremendous distention of the small intestine in right half of abdomen. Distended loops are also visible in left half indicating an adynamic ileus compatible with peritonitis. A catheter is noted in the stomach, another is seen in the rectum (Case 1).

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* From the Surgical Services of Dr. Nicholas H. Ryan and Dr. Ottokar Tenopyr, Kings County Hospital, Brooklyn.

foration. The large intestine was collapsed throughout its entire length. The matted ileum, including the membranous area was resected. A side-to-side ileocolostomy was then performed. Routine closure of the abdomen was accomplished. The condition of the infant on leaving the operating room was very poor. Ten hours after the operation the infant died. Autopsy study attributed the death to meconium peritonitis.

Comment. Congenital atresia of the ileum is not seen frequently. Without surgical intervention death from dehydration and inanition is inevitable. Atresia of the small intestine occurs in two forms. One type is an internal membrane occluding the lumen. The second type is a sudden ending of the intestinal tract as a blind sac.[1]

Ladd and Gross report forty-one cases in which the patients were operated upon for congenital atresia of the ileum with only five patients surviving. Hence it can be appreciated how uncommon is this entity and how high is the operative mortality. It is rare to find this condition associated with a perforation proximal to the atresia as recorded in this case.

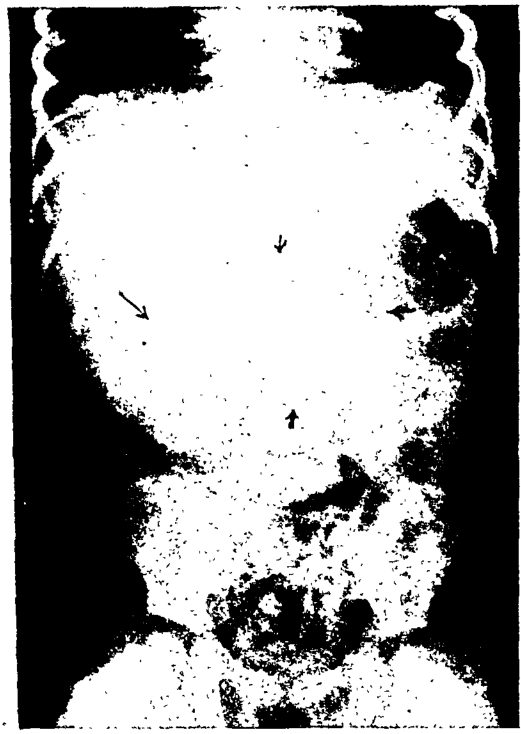

Fig. 2. Flat plate x-ray of abdomen showing a mass in right upper half of the abdomen. Intussusception suggested in transverse colon (Case II).

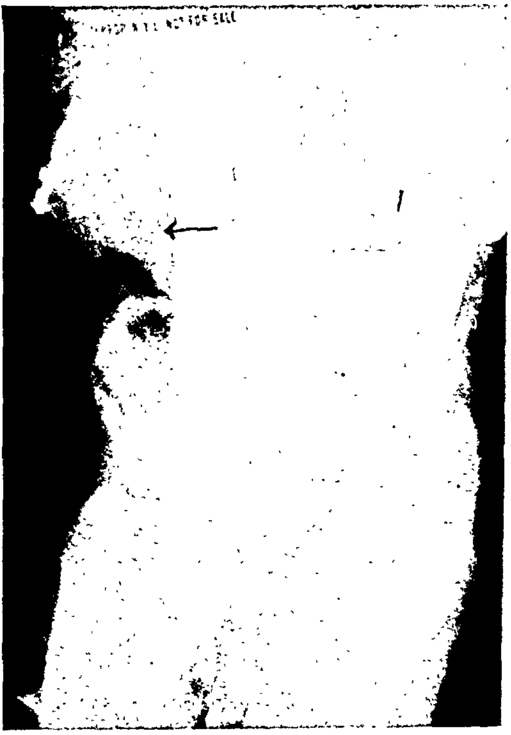

Fig. 3. Preoperative barium enema revealing an obstructive process due to an intussusception in the ascending colon. Barium has pushed the intussusception from the transverse to the ascending colon (Case II).

In the discussion of this subject Ladd and Gross mention Farber's test as an aid in diagnosis. This is a microscopic test whereby the meconium of an infant can be quickly examined and the presence or absence of swallowed vernix cells can be determined. This is performed by staining a fresh specimen of meconium on a slide with gentian violet and then examining the specimen under a microscope. In any newly born child with intestinal obstruction, the absence of cornified epithelial cells in the meconium is presumptive evidence that an intestinal atresia exists.[1]

Case II. This is the case history of a twenty-three month old colored boy who was admitted to the pediatric medical service on

June 23, 1943. The history was one of constipation of five days' duration. Small fecal particles were passed by rectum on alternating days during this five-day period. It was noted that the child would hold his abdomen with his hands and flex his legs on the abdomen. He would do this innumerable times. Associated with this procedure was the facial expression of pain. Vomiting occurred twice during the physical examination. Oliguria was present since the onset of symptoms. No blood was passed by rectum; none was found on the examiner's finger.

On admission the temperature, pulse and respirations were within normal limits. The abdominal findings at this time were nonrevealing. The abdomen was soft, no tenderness could be elicited, no masses were palpable. A small umbilical hernia was present. Laboratory and blood studies were normal.

On June 28th, five days after admission, a surgical consultation was requested. The patient was accepted on the surgical service with the tentative diagnosis of intestinal obstruction possibly due to an intussusception. X-ray studies were requested. (Figs. 2 and 3.)

At this time the patient had several loose, brown; watery stools. He retained fluids by mouth but no solid food. The next day the abdomen became moderately rigid on the right side; tenderness could be elicited in the right lower quadrant. A questionable mass could be felt in the right lower quadrant. There was no blood per rectum and no mass could be felt by digital rectal examination. All this time the temperature and pulse rate did not rise.

Surgery was advised after intravenous fluids and a blood transfusion had been given. The patient underwent an exploratory laparotomy on the seventh day of admission to the hospital. The abdomen was opened through a right paramedian incision. A moderate amount of clear, yellow fluid was aspirated from the peritoneal cavity. A double intussusception was found in the right colon extending up to the hepatic flexure. The terminal ileum was invaginated into the cecum. The cecum in turn was invaginated into the ascending colon up to the hepatic flexure. The appendix was drawn into the ascending colon by the cecum. The appendix was reddened, edematous, congested and macroscopically enlarged. The lateral ligamentous fold of the ascending colon was absent. The right half of the colon was extremely mobile. The intussusception was reduced in the orthodox fashion. The intestine was viable. A small amount of hemorrhage in the serosa of the cecum was present. Slight to moderate edema of the cecum was noted. After the reduction of the intussusception an appendectomy was performed. The terminal portion of the ileum and the cecum were sutured down to the posterior parietal peritoneum. Abdominal closure was accomplished in the routine fashion.

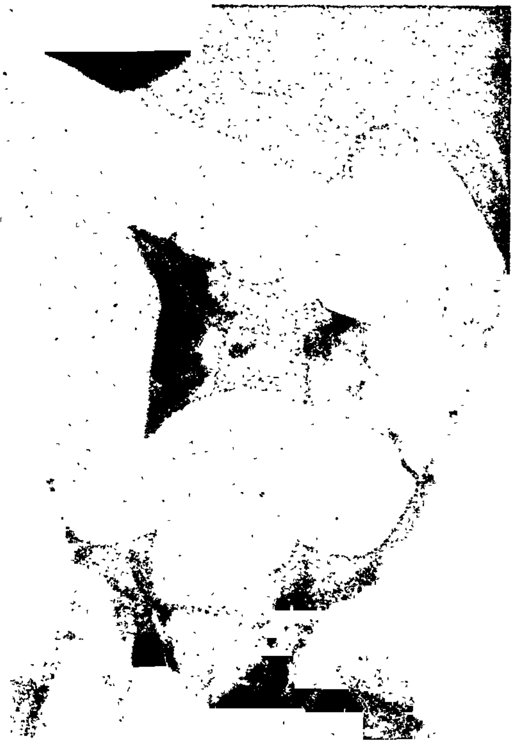

Fig. 4. Postoperative barium examination revealing no obstruction to the passage of the opaque material through the entire colon. The intussusception formerly present is completely reduced (Case II).

Postoperatively the patient was given intravenous fluids. On the second postoperative day the temperature rose to 102°F. on one occasion. Abdominal distention on the third and fourth days was combatted with Wangensteen suction. No other complication developed. Four weeks after the operation a barium study of the colon showed complete reduction of the intussusception. (Fig. 4.)

Comment. Intussusception is a surgical disease infrequently seen. Over a thirty-year period Ladd and Gross reported 484 cases. Of this number only 1 per cent showed multiple intussusception. Thus the rarity of this state is readily appreciated.

Intussusception in childhood may find an etiological basis in a Meckel's diverticulum, intestinal polyp, lymphoma or duplication. In most instances no etiological agent can be found.[1] In the case reported, it is believed that the free mobility of the ascending colon, due to the absence of a lateral attachment, was a contributing factor.

Intussusceptions are spoken of in compound terms which indicate the portion of the intestine (intussusceptum) which telescopes into the intussuscipiens.[1] Multiple types are reported. These are usually ileo-ileo-colic.[1] Ladd and Gross do not mention an ileo-cecal-cecal-colic type as found in this case. This we believe to be a rare condition.

The other unusual features of this case were the delayed physical findings, and the absence of bloody stools with a complex pathological process. Another interesting aspect was the long interval between the onset of symptoms and the time of operation. Prolonged delay such as this almost always terminates fatally. The explanation offered for the bizarre clinical picture is that the intussusception reduced itself only to recur.

SUMMARY

Two unusual pediatric cases are presented. The first is a congenital atresia of the ileum associated with spontaneous intestinal perforation in a premature infant. This infant developed signs of an intestinal obstruction within twenty-four hours after birth. Surgical intervention failed in the presence of an extensive peritonitis.

The second case is a double intussusception in a twenty-three months old boy who presented a five-day history prior to entering the hospital. An additional delay of seven days occurred before surgical relief of the intussusception was accomplished. Notwithstanding this prolonged delay, the patient had an uneventful recovery.

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INTESTINAL OBSTRUCTION ASSOCIATED WITH DEFECTS IN THE BROAD LIGAMENTS OF THE UTERUS

REVIEW OF LITERATURE AND CASE REPORT

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INTESTINAL obstruction following protrusions and strangulation of loops of bowel through defects in the broad ligaments of the uterus is decidedly uncommon, and only twenty-seven such cases are to be found in the literature. Nine of these cases are definitely associated with the Baldy-Webster operation for uterine suspension and one case was found during a third cesarean operation. There are four additional cases reported in the literature of broad ligament defects which are not associated with intestinal obstruction. It is interesting to note that many of these cases are referred to as "broad ligament hernias" when actually they are protrusions of loops of intestine through fenestra in the broad ligament without any form of hernial sac. These cases should more correctly be called "intestinal obstruction by strangulation into or through the broad ligaments." In this paper such a case is presented and reference is made to other cases thus far reported in the literature which are definitely related to broad ligament defects.

CASE REPORT

Mrs. H. C. B., age forty-two years, entered the H. F. Long Hospital January 12, 1941, with severe lower abdominal cramping pain which was accompanied by nausea and vomiting of eight hours' duration. She was awakened at 5:00 A.M. on the day of entry into the hospital with severe cramping pain in the hypogastrium. The pain gradually increased in severity, became continuous and agonizing, and was accompanied by regular intermittent colicky pains of short duration which radiated straight upward to the epigastrium. Nausea was almost continuous but during the episodes of colicky pain it became more intense and on three occasions was accompanied by vomiting. The patient was given morphine by the family physician shortly after the onset of pain but this produced only slight relief. The patient then sought relief by lying on her left side with the lower extremities flexed onto the abdomen, but the symptoms continued without abate until admission to the hospital at 12:00 noon.

During the past year the patient had noticed morning nausea but this was never accompanied by pain, vomiting, or any disturbance of bowel habits. On the day prior to the onset of her illness she had a good bowel movement and felt quite well, and during the evening took several high balls and ate much rich food.

Her general health in the past had always been excellent and there had been no operations or significant injuries. The last menstrual period occurred on January 4, 1941, and was of the usual duration and flow. There had been three pregnancies; all the children were living and well and at the present time were fifteen, ten, and five years old, respectively. The first pregnancy necessitated a version extraction for abnormal presentation, but the others were normal labors. Further history is noncontributory.

Examination on entry into the hospital showed a well developed, acutely ill woman tossing about in bed and complaining of severe lower abdominal pain. Her temperature was 97°F., pulse 78, respirations 18, and blood pressure 120/72. There was slight abdominal tenderness and increased muscle tone just above the symphysis pubis, but no distention, masses, or increased audible peristalsis. Pelvic examination showed a normal size retroverted uterus which was tender on manipulation. There was tenderness in the left fornix but no palpable masses. The remainder of the physical examination was normal.

Laboratory findings on admission: Hemoglobin, 77 per cent (16 Gm. Dare method); white blood count, 6,700, polymorphonuclears, 72 per cent, coagulation time, three minutes; urinalysis essentially negative and Kahn test negative.

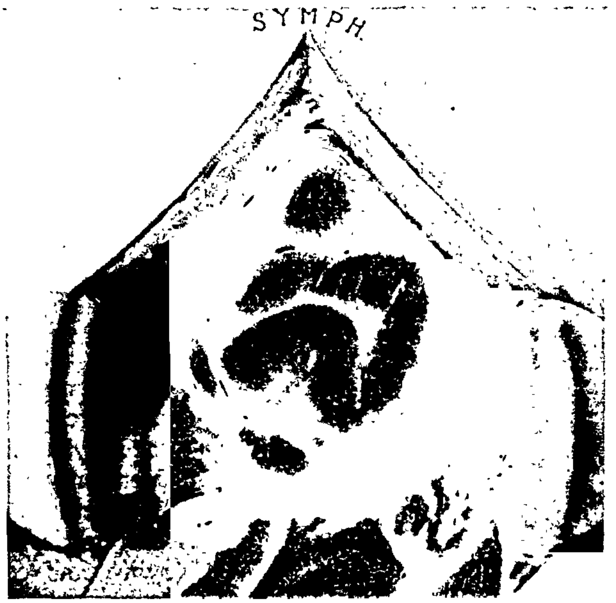

Fig. 1. A loop of ileum protruding through a defect in the left *meso-ligamentum teres* and partially obstructed by the round ligament which at this level is greatly hypertrophied. The uterus is retroverted but freely movable. Pelvic organs are otherwise normal.

It was decided that an immediate laparatomy was inadvisable because of the lack of definite objective signs. The patient was given nothing by mouth, intravenous fluids, and opiates for relief of pain. However, the pain continued but did not appear to increase in severity and she vomited only a few times. The vomitus was always clear and watery and very small in quantity. Temperature, pulse, and respiration remained well within normal limits. Daily blood counts and urine examination were always within normal limits. The abdomen was never distended and she continued to have small daily stools without blood or mucus.

Due to persistence of symptoms the abdomen was explored four days after admission to the hospital. On opening the abdomen through a midline suprapubic incision, loops of distended small intestine and increased cloudy peritoneal fluid were encountered. The obstruction was traced to the left pelvis where a loop of terminal ileum 18 inches long was found strangulated beneath the left round ligament. The bowel entered superiorly through an opening beneath the round ligament and lay anteriorly on the broad ligament and uterus. (Fig. 1.) The bowel was easily released by gentle traction, and though it was quite distended and discolored it was viable and soon regained normal appearance. The opening through the left mesoligamentum teres of the anterior leaf of the broad ligament was 3 cm. in diameter. The round ligament at this level was greatly hypertrophied and approximately three times its normal size. Further inspection of pelvic viscera was negative. The defect was closed by suturing its edges securely with chromic catgut No. 0 to the round ligament above. Recovery was uneventful and the patient left the hospital on the twentieth postoperative day.

The patient has had no recurrence of symptoms during the past two and one-half years since operation. (Fig. 1.)

LITERATURE

The earliest record of intestinal obstruction by strangulation of loops of bowel into or through the broad ligament was in 1861 when Quain reported the autopsy findings of a woman who died as a result of this type of obstruction without intervening surgical treatment. This is the only case to appear in the literature prior to the twentieth century.

In 1910, Barnard stated that hernia may occur into pouches in the broad ligament and mentioned that there was such a case in the Museum of the London Hospital, but this case could not be traced by Pidcock. A monograph by Moynihan in 1906, "Internal Hernia" contains no reference to broad ligament hernia, and Watson's "Hernia" likewise does not refer to this condition.

Fagge, in 1917, reported two cases of strangulated hernia into the broad ligament, the first instance of surgical intervention in the literature. In 1920, Barr reported another similar case and during the same year the first instance of intestinal obstruction following and definitely associated with the Webster-Baldy operation was reported by Richardson. Pidcock reported another case in 1924, of strangulation of a loop of bowel through an aperture in the broad ligament and discussed the possible etiology of this condition. In 1926, Dunn reported a case in which there was a fenestra 5 cm. in diameter in the mesosalpinx of both broad ligaments without strangulation of the bowel. In 1928, Dorman described a case of true broad ligament "hernia" similar to a Richter's hernia, in which a knuckle of intestine was strangulated in a sac formed by an invagination of peritoneum on the posterior surface of the left broad ligament. Stimson added another case in 1928 and Janes two cases in 1929, of intestinal strangulation through openings in the broad ligaments. Pemberton and Sager, in 1929, reported two cases following the Webster-Baldy operation. Caplan, in 1930, and Cooper, in 1931, added two other cases of strangulation of bowel into the broad ligament and referred to another case of Hermann in 1925, and reviewed the literature in an excellent manner. Masson and Atkinson reviewed the literature in 1934 and reported a case of herniation of the right ovary and part of the Fallopian tube into a fold of the right broad ligament. In 1937, Reineke reported the autopsy findings of a case of intestinal obstruction through or into an opening in the right mesosalpinx, and Füssell reported a similar case in 1938 in which the patient expired two days after operation. Likewise, in 1938, Pohn and Votquenne reported a case of "strangulated hernia in hiatus of broad ligament after Baldy Dartigues operation for retroversion of the uterus." Also during that year Masmonteil and Vautier reported a case of intestinal obstruction during pregnancy where the sigmoid was strangulated in a breach of the broad ligament. In 1939, Bowles reported two cases, one, of strangulation of the bowel through the left mesosalpinx, and another which followed the Webster-Baldy operation. During the same year Parks and Karabin reported a case following the Webster-Baldy operation and referred to two other similar cases. In 1940, Bartsch presented a case of "strangulation of intestine due to hiatus formation in broad ligament." Koch reported two cases in 1940, one, which was quite similar to the author's in which a loop of ileum was strangulated beneath the left round ligament, and another case of intestinal obstruction following the Webster-Baldy operation. Shephard and Waugh reported an unusual case in 1924 of hernia into the suspensory ligament of the right ovary producing acute intestinal obstruction. In this case the defect was 1¼ inches in diameter and was thought to be congenital in origin.

Thus a total of thirty-one cases from the literature and the case presented here represent all known cases to date of fenestra or defects in the broad ligaments of the uterus which may or may not be associated with intestinal obstruction.

ANATOMY

Anatomically, the broad ligament is a reflection of peritoneum extending laterally from the surface of the uterus to the pelvic walls with the tubes and round ligaments acting as ridgepoles. The Fallopian tubes being somewhat superior and posterior to the round ligaments are covered by the same reflection of peritoneum, except at the fimbria, and mark the superior boundary of the broad ligaments. Laterally, the peritoneum extends to the pelvic wall covering the ovarian vessels to form the infundibulo-pelvic ligament or the suspensory ligament of the ovary.

The ovary is located on the posterior aspect of the broad ligament beneath the tube and ligamentum proprium ovarii, the latter representing a thickening of the posterior layer of the broad ligament extending between the ovary and the cornu of the uterus. This ovarian ligament divides the broad ligament into two parts; the upper triangular portion being the *mesosalpinx* and is bounded by the uterus medially, the ovary laterally, and the Fallopian tube superiorly. The lower portion is actually the broad ligament proper and contains a shallow fossa immediately above the round ligament where the folds of peritoneum forming the broad ligament are in close apposition and are quite devoid of connective tissue support and adequate blood supply. The round ligaments on each side stretching, ordinarily lax, between the canal of Nuck and the anterolateral surface of the uterus are covered by the anterior layer of the broad ligaments to form the *mesoligamentum teres*.

Where the peritoneum is reflected on the pelvic wall the loose connective tissue between the folds of the broad ligament become continuous with the connective tissue of the pelvic floor and forms a rather strong support to the broad ligaments.

COMMENT

Except in those cases associated with previous pelvic surgery, it is difficult to determine the etiology of broad ligament defects. Such defects are probably congenital in origin because it is inconceivable that trauma could be an etiological factor. It is likely that pregnancy plays an important rôle because it was found in the literature that only three of the seventeen patients, not operated upon previously, were definitely nulliparous. The average age of these seventeen patients was about forty-three years, the youngest, an eighteen year old nulliparous woman whose broad ligament defect was found during an operation for ovarian tumor, and the oldest a seventy year old multiparous woman with complete intestinal obstruction. In only one instance did intestinal obstruction occur during or shortly after the termination of pregnancy, which would tend to disprove any theory of intra-abdominal pressure during pregnancy and labor producing a tear or defect in the broad ligament with subsequent strangulation of the bowel.

An interesting observation is that the defects in sixteen patients, without previous surgery, were located in the region of the mesosalpinx involving both layers of the broad ligament. There are two cases of "pouch" formation located on the posterior surface of the broad ligament and two cases of protrusion of a loop of bowel beneath the round ligament similar to the case presented above.

Despite the fact that the mesosalpinx is a thin avascular region of the broad ligament it is unlikely that stretching or direct pressure by loops of bowel could produce these defects. However, trauma by repeated protrusions of loops of intestine into congenital fenestra might produce sufficient inflammation with resultant fibrous tissue sufficiently strong to strangulate the bowel. Thus it is to be expected that the actual production of the condition necessary for intestinal obstruction requires many years of this repeated mild trauma. Such must be the case since the average age of patients with this condition is about forty-three years.

Those cases without intestinal obstruction were found to have quite large defects incapable of producing constriction of the bowel. Thus the size of the defect, the amount of tissue resistance locally in the form of a fibrous rim about the fenestra, and the age of the patient must all be factors in producing this type of intestinal obstruction.

Intestinal obstruction following the Webster-Baldy operation for uterine suspension has already been nicely presented by Parkes and Karabin, and the broad ligament defects have been attributed to a technical error in performing this operative procedure. Here the openings in the broad ligament have occurred at the point where the round ligament was brought through to be sutured to the posterior surface of the uterus. In order to prevent such complications the technic as outlined originally should be closely followed. Care should be taken to perforate the broad ligament immediately below the ovarian ligament and proximal to the uterus. The openings in the broad ligament should only be large enough to permit the pulling through of the round ligaments, and at the end of the procedure the edges of the openings in the broad ligaments should be carefully sutured to the round ligaments so that no opening or raw surface is left.

DIAGNOSIS

An accurate preoperative diagnosis of this condition has not yet been made, although Pemberton and Sager once diagnosed an incarcerated intra-abdominal hernia which at operation was found to be strangulation of a loop of bowel through an opening in the left broad ligament. Diagnosis is quite difficult when there is partial intestinal obstruction as shown in the case presented above. In this case all symptoms and signs were entirely subjective except the occasional vomiting of clear gastric contents, and the slight tenderness on manipulation of the uterus. During the three days prior to operation there was a constant lack of fever, leucocytosis, abdominal distention, and persistent vomiting. Exploration of the abdomen was performed, for the most part, only because of persistent abdominal pain.

In cases with complete intestinal obstruction a preoperative diagnosis can be made. Signs of complete obstruction in a multiparous woman with pelvic tenderness and a mass in the region of the broad ligament without evidence of acute pelvic inflammatory disease should make such a diagnosis quite likely. History of previous pelvic surgery is likewise significant.

Treatment is always surgical. Abdominal exploration should be performed as early as possible after onset of symptoms because this alone will influence the prognosis and mortality rate. At operation an attempt should be made to obliterate the broad ligament defect even at the expense of the tube and ovary. The importance of using non-absorbable suture cannot be too greatly stressed when this method of repair of the defects is used.

SUMMARY

1. A case of intestinal obstruction associated with a defect in the broad ligament of the uterus is presented along with a review of the literature.
2. Those cases associated with previous pelvic surgery particularly the Baldy-Webster suspension operation, were discussed only briefly.
3. Defects in the broad ligaments which are not associated with previous pelvic surgery must be congenital in origin, although repeated trauma must play an important rôle.
4. A definite preoperative diagnosis is difficult to make in the absence of complete intestinal obstruction and a definite history of previous pelvic surgery.

The authors are deeply grateful to Mr. Elon Clark, Duke Medical School, Durham, N. C. for the excellent illustration.

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PEPTIC ULCER PERFORATING INTO THE ANTERIOR ABDOMINAL WALL*

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CHRONIC, slowly progressive perforation is a common complication of peptic ulcer. If the ulcer becomes attached to an adjacent organ, it may continue its penetration into the substance of that organ. Eusterman and Balfour stated that solid organs are very resistant to such penetration. Eberhardt, at the necropsy of a patient who had died of carcinoma of the colon, found a huge ulcer of the stomach which had penetrated through the diaphragm, had attached itself to the wall of the left ventricle of the heart and had burrowed into the ventricular muscle to a depth of 3 mm. The frequency with which duodenal ulcer penetrates into the substance of the pancreas is well known.

Eusterman and Balfour stated that perforation, whether it be acute, subacute or chronic, is characteristic of the majority of jejunal ulcers. They stated that this perforation in order of frequency occurs, first, into the peritoneal folds, second, into the colon, and third, into the abdominal wall. The infrequency with which peptic ulcer penetrates into the anterior abdominal wall is attested by the paucity of reports of this complication. Plewniak reported the occurrence of a gastric ulcer which became attached to the anterior abdominal wall, penetrating into it and forming an inflammatory mass the size of two fists. Petrov reported a jejunal ulcer which perforated into the anterior abdominal wall twelve years after gastroenterostomy had been performed. Recht reported a case in which a perforating jejunal ulcer had become attached to the anterior abdominal wall and subsequently burrowed through the abdominal wall to form an external fistula with the discharge of gastric contents. Recht, in calling attention to the infrequency with which the complication attends jejunal ulceration, credited Schwartz with having collected data on fifty-three cases in which a jejunal ulcer had become implanted on the anterior abdominal wall.

We recently had the opportunity of observing a jejunal ulcer which had perforated into the anterior abdominal wall. Subsequently we were able to find two additional similar cases in the files of the Mayo Clinic.

CASE REPORTS

CASE I. A man, aged sixty-eight years, was examined in 1939 at the Mayo Clinic because of stomach trouble. He had had some form of indigestion for at least thirty-seven years. He had been a moderate user of alcohol and tobacco throughout his adult life. He was first seen at the clinic in 1915, when a diagnosis of duodenal ulcer was made. At that time posterior gastrojejunostomy was performed for a chronic perforating duodenal ulcer. An excellent result followed this procedure and the patient remained symptom free for twelve years. In 1927, he had a recurrence of severe gastric pain which was uncontrolled by the usual medical measures formerly effective. His abdomen was explored in 1927 elsewhere. The original gastrojejunal stoma was not disturbed, and anterior gastrojejunostomy was performed. An uncomplicated recovery followed this second operation and he remained well except for transient digestive discomfort until 1939.

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* The opinions and assertions contained herein are the private ones of the writers and are not to be considered as official or reflecting the views of the Navy Department or the naval service at large.

Ten weeks before the patient's admission in December, 1939, he had noted a painful tumor in the site of the scar of his previous laparotomy incision. This tumor had increased in size slowly until it had measured approximaterly 2½ inches (6.25 cm). in diameter. There had been no return of significant digestive distress and his health in general was excellent.

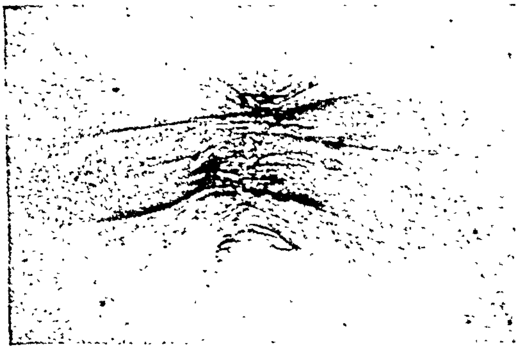

FIG. 1. Anterior abdominal wall showing the deformity secondary to the inflammatory reaction caused by a contiguous gastrojejunal ulcer.

The patient was tall and asthenic and weighed 20 pounds (9.1 kg.) less than the weight that was ideal for him. The mid-epigastric wall was involved by a brawny red indurated mass measuring 6.25 cm. in diameter. The skin over this region was thrown into coarse irregular folds. (Fig. 1.) There was a small right inguinal hernia. The systolic blood pressure was 180 mm. of mercury; the diastolic was 100 mm. The voided urine was normal. The concentration of hemoglobin was 12.7 Gm. per 100 cc. of blood; the leukocytes numbered 8,200 per cubic millimeter of blood. The Kline, Kahn, Hinton and Kolmer Wassermann tests of the blood serum gave normal results. A modified Ewald test meal showed a total acidity of 60 (according to the method of Töpfer), a free hydrochloric acid of 50 and total aspirated contents of 60 cc. A roentgenogram of the stomach was reported as follows: "The distal third of the stomach is badly scarred from previous gastric operations which have interfered with normal physiology. There is a low gastro-enterostomy with a jejunal ulcer and rather marked jejunitis." (Fig. 2.) A roentgenogram of the thorax did not show any abnormality.

An operation was performed on January 5, 1940, by one of us (W. W.). It was found that the mass in the abdominal wall formed the base of a huge gastrojejunal ulcer. This ulcer arose from the anterior portion of an anterior gastrojejunal stoma that had been made secondarily elsewhere. The crater of the ulcer was approximating 4.5 cm. in diameter and was removed with a portion of the abdominal wall including the umbilicus. The original posterior gastrojejunal stoma made twenty-five years before had contracted so that it measured approximately 1.2 cm. in diameter. A scarred, healed duodenal ulcer narrowed the duodenum to half its normal diameter. (Fig. 3.)

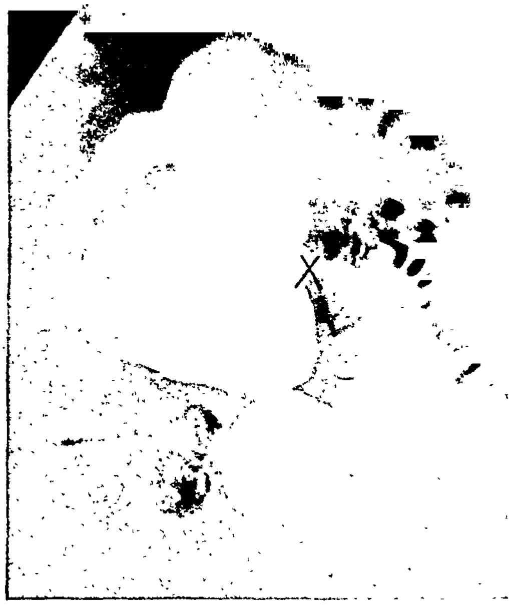

FIG. 2. Great deformity of the lower third of the stomach and at (x) area of jejunitis. The jejunal ulcer visualized at roentgenoscopic examination is not visible in the roentgenogram.

The posterior gastrojejunal stoma was taken down, the duodenum was divided just below the pylorus and four-fifths of the body of the stomach was resected. Gastrointestinal continuity was re-established by means of a posterior Pólya type of anastomosis, approximating to the stomach a loop of jejunum about 7.5 cm. distal to the second opening, which had been made by the anterior gastrojejunostomy and which was closed at this time.

The postoperative course was complicated by bronchopneumonia, but the patient made a good recovery eventually and was dismissed from our care two months from the time of admission.

Case II. A white man, aged thirty-six years, was first seen at the clinic in 1914. At that time he gave a history of an ulcer type of dyspepsia of one year's duration. Physical examination gave normal findings. The Kolmer Wassermann reaction of the blood was negative. A modified Ewald test meal revealed total acidity of 64 (according to the method of Töpfer), a free hydrochloric acid of 52 and total aspirated contents of 100 cc. A roentgenogram of the stomach was indeterminate.

The patient returned in 1917 because of persistent gastric distress. Abdominal exploration was done and posterior gastrojejunostomy performed for a chronic perforating duodenal ulcer. He remained well after this for sixteen months and then experienced recurrent pain, situated to the left of the umbilicus. A roentgenogram revealed a jejunal ulcer. Abdominal exploration was performed in September, 1918. A jejunal ulcer was found adherent to the colon and reducing the gastrojejunal stoma to half its normal size. The anastomosis between the stomach and the jejunum was disconnected and the openings in the stomach and the jejunum were closed. A second gastrojejunostomy was performed with the stoma somewhat nearer the pylorus. Two years after this second operation the patient had a return of symptoms. In 1924, a jejunal ulcer was demonstrated by roentgenogram. In 1926, he discovered a tender mass in the upper end of the laparotomy scar. Examination revealed moderate local inflammatory changes about this mass.

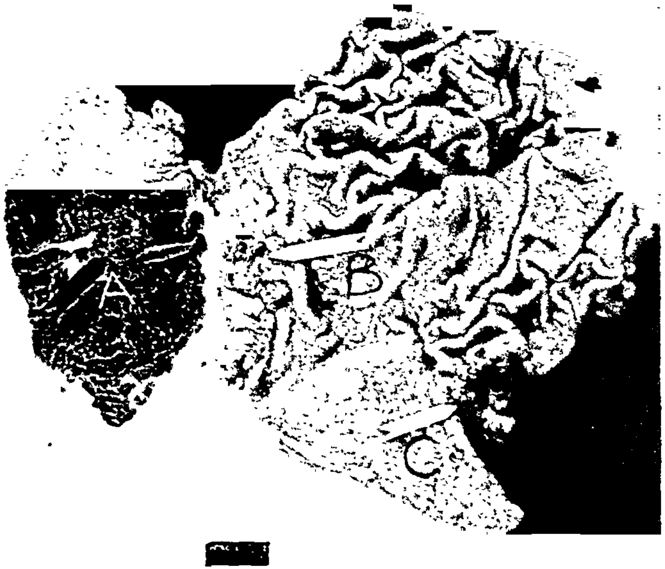

Fig. 3. Segment of the stomach removed at the time of operation showing (A) the base of gastrojejunal ulcer perforating into the anterior abdominal wall; (B) site of anterior gastrojejunostomy; (C) site of obsolete posterior gastrojejunostomy.

An operation was performed in November, 1926. When the abdomen was opened, it was found that the palpable mass was due to inflammatory reaction about an ulcer which arose from the anterior gastric wall. This ulcer had become attached to the anterior abdominal wall, penetrating through the entire wall and forming a crater whose base was beginning to penetrate into the skin itself. The base of the ulcer measured 2.5 cm. in diameter. Because of the secondary inflammatory reaction it was impossible to mobilize the stomach sufficiently to permit removal of the lesion. The ulcer was therefore oversewed and ten days later a secondary operation was performed. At this time it was found that the anastomosis present was an anterior gastrojejunostomy. There was a jejunal ulcer arising from the site of the anastomosis and slightly to the left of the gastric ulcer previously found. This jejunal ulcer was penetrating into the anterior abdominal wall. The stomach was mobilized and the lower half resected. The gastrointestinal continuity was re-established by a Balfour Pólya type of anastomosis. The patient made a good recovery after a stormy convalescence. His gastric symptoms were well controlled for eight years after this operation. He died in 1934 after a severe gastric hemorrhage.

Case iii.* A man, aged thirty-seven years, registered at the clinic in 1923. He gave a history of having had recurrent epigastric distress for approximately ten years. In 1915, appendectomy had been performed. In 1916, gastro-enterostomy for chronic duodenal ulcer was performed. One month after this operation there was recurrence of distress which had shifted its location to the left and slightly lower as compared with his original distress. This recurrent pain was not relieved as promptly by the ingestion of food as was his pain before the operation. He followed a modified ulcer dietary regimen for several years but failed to obtain good relief therefrom.

On examination there was evidence of recent loss of weight. There was a palpable mass in or just beneath the abdominal wall to the left of the midline. The blood pressure was 106 mm. of mercury systolic and 80 diastolic. Urinalysis gave normal results. The concentration of hemoglobin was 79 per cent (Dare); the leukocytes numbered 7,300 per cubic millimeter. The blood Wassermann reaction was negative. A modified Ewald test meal showed a total acidity of 56 (according to the method of Töpfer) and free hydrochloric acid of 42. A roentgenogram showed a negative stomach and a functioning gastro-enteric stoma.

The stomach was explored in June, 1923. It was found that an anterior gastrojejunal stoma had been made at a previous operation. The anterior wall of the stomach was adherent to the anterior abdominal wall, and when these structures were separated, an ulcer arising from the edge of the gastro-enteric stoma was seen penetrating into the substance of the abdominal wall. The crater of the ulcer measured 1 cm. in diameter and 1 cm. in depth. The pylorus was contracted to ¼ inch (0.6 cm.) in diameter. The crater of the ulcer was excised, the anterior lip of the gastrojejunal stoma was reconstructed and the area protected by a portion of omentum.

A return of ulcer-like abdominal pain was experienced one year after this operation. This distress was located in the left upper quadrant of the abdomen with occasional extension into the scrotum and inner aspect of the left thigh. The pain was relieved by the taking of an alkaline powder.

In 1926, a tender mass was palpable in the left half of the abdomen. This mass seemed to be attached to the anterior abdominal wall. The patient was underweight and dehydrated. A roentgenogram revealed a gastrojejunal ulcer. After a few days of preparation an abdominal exploration was performed. An ulcer was found to be arising from the anterior portion of the gastrojejunal stoma. This ulcer had become attached to the anterior abdominal wall and had penetrated into it, forming a crater 2 cm. in depth and 4 cm. in diameter. The crater in the abdominal wall was excised, the gastro-enteric stoma was disconnected and the removal of two-thirds of the stomach effected by resection. Gastrointestinal continuity was re-established by means of a Balfour Pólya type of anastomosis. The patient made an uncomplicated recovery from this operation and an inquiry nine years later revealed that he had not had any return of digestive disturbance during that time.

COMMENT

We should like to draw attention to the fact that the complication of peptic ulcer manifested in these three cases is one which is infrequently seen. That penetration of a peptic ulcer into the anterior abdominal wall can occur is evident. In our second case this penetration had extended into the skin and there seemed to be a possibility of actual formation of fistula, a complication which Recht observed. All our patients had had previous operations on their stomachs, and in each instance anterior gastrojejunostomy had been performed. In each instance the offending lesion was an ulcer arising in the anterior rim of the anterior gastrojejunal stoma. It is apparent that in order that a peptic ulcer can attach itself to the anterior abdominal wall and secondarily penetrate into it, the ulcer must have its origin from a part of the stomach wall which is adjacent to the abdominal wall. A gastrojejunal ulcer arising on the anterior rim of an anterior gastrojejunal stoma is, therefore, peculiarly likely to penetrate in such a way as to result in this complication.

When it is decided that gastrojejunostomy is the procedure of choice in the surgical treatment of duodenal ulcer, posterior anastomosis is always done in preference to anterior anastomosis. A better functional result is achieved by the former procedure. Anterior gastrojejunostomy is done only when posterior anastomosis is not technically feasible and this is uncommon. For these reasons anterior gastrojejunostomy is performed in very few cases and consequently few gastrojejunal ulcers are situated in a location which makes anterior penetration of the ulcer into the anterior abdominal wall anatomically possible. Although it is possible for a gastric ulcer having its origin in a part of the anterior gastric wall adjacent to the anterior abdominal wall to penetrate into the abdominal wall as Plewniak observed, this complication must be exceedingly rare in a stomach which has not been previously disturbed by operation. In Case II two ulcers were found penetrating into the anterior abdominal wall; one proved to have its origin in the gastric wall, the other arose from the jejunum.

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* Previously reported by Nickel and Hufford.

SUMMARY

Three cases are reported in which a benign peptic ulcer occurred at the stoma of an anterior gastrojejunostomy. These ulcers became attached to and burrowed deeply into the anterior abdominal wall. This is a rare complication of peptic ulcer. When it occurs, it must be treated surgically.

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VALVULAR GASTROSTOMY*

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WHEN the surgeon has the occasion to perform a gastrostomy, he may choose from a number of well established methods. In a recent article, the writer pointed out the disadvantages of the fistulous tracts lined by serosa.[1] In spite of the ease with which the Witzel and other similar types of gastrostomies are performed, they have their disadvantages, since leakage and soiling cannot always be prevented. A rubber tube must be permanently in place; otherwise the fistula may close up. On the other hand, there is no danger of any pedicle tube gastrostomy closing up because it is lined with stomach mucosa. The Beck-Jianu[2] gastrostomy demands the sacrifice of a large part of the stomach along the greater curvature. The Janeway[3] and the Spivac[4] methods sacrifice less of the stomach wall and eliminate the danger of hourglass formation. I have had no personal experience with the double-valve gastrostomy described by Glassman.[5] It appears to be a simple and safe procedure.

In a recent communication the writer proposed a valvular form of gastrostomy fashioned from a flap of the anterior stomach wall. (Figs. 1, 2 and 3.) First a channel was formed by suturing the seromuscularis over a rubber tube. Such a pedicle tube was rather long and maintained its continuity with the main body of the stomach by a narrow base. This pedicle tube was then invaginated upon itself, creating a valve-like structure resembling the ileocecal valve, only much longer in its lumen. This type of gastrostomy was performed in one patient with carcinoma of the esophagus and it functioned efficiently. Although the length of the pedicle tube was about the same as that in the Janeway or Spivac methods, it appeared to be unsafe, since the invagination upon itself might have a tendency to strangulate the blood supply to the terminal part of the tube.

In the newest technic depicted in the illustrations, one can see that the length of the finished gastrostomy remains about the same as in the original one. This was accomplished by separating only the terminal half of the pedicle tube from its continuity with the main body of the stomach. The proximal half of the pedicle tube closer to the greater curvature has not been disturbed. Such a procedure allows the blood supply to come in from all sides of the main body of the stomach to the distal half of the gastrostomy tube. By providing a wider diameter in the proximal half of the channel, no strangulation should take place after the invagination of the narrow terminal half of the gastrostomy tube. Such invagination was accomplished with ease. The illustrations depict the various steps of the operation.

CASE REPORT

R. G. H., Case No. B-38975, a male, age fifty-eight, was admitted on October 14, 1942, because of difficulty in swallowing and of vomiting recently swallowed food, gas on the stomach, and loss of weight. This patient had enjoyed very good health until about three years ago, when he began to notice considerable abdominal gas after meals. This gas seemed to have no relation to the food eaten, and continued to occur until the present time. About five months ago he noticed difficulty in swallowing large pieces of food. This condition has become considerably worse. During the past two months his diet has been largely

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* From the Department of Physiology, University of Oregon Medical School.

Fig. 1.

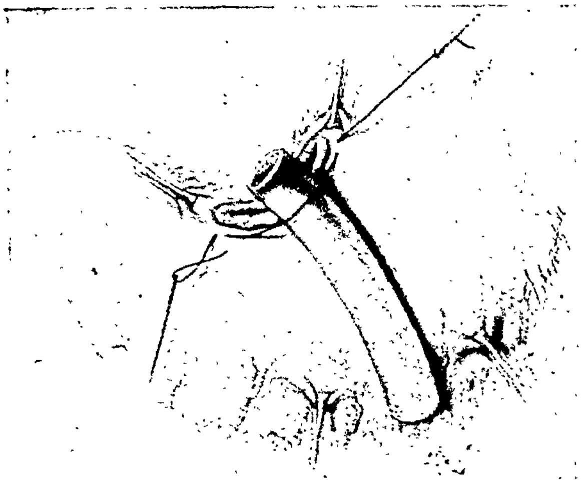
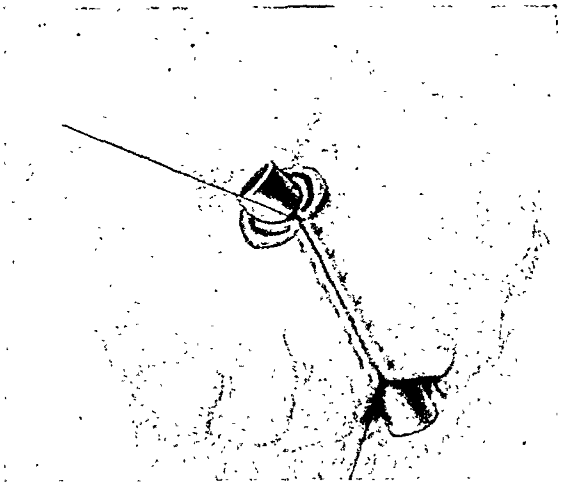


Fig. 2.



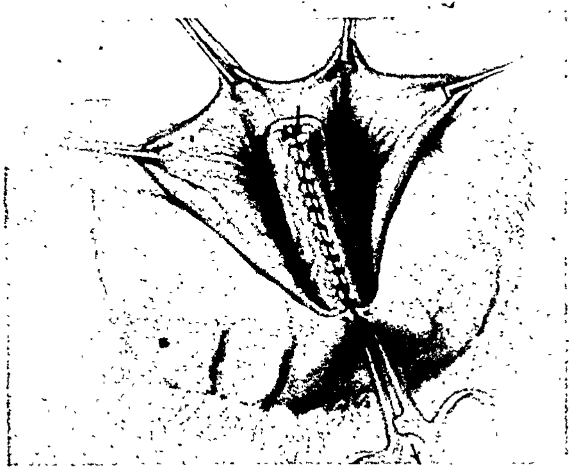


Fig. 3.

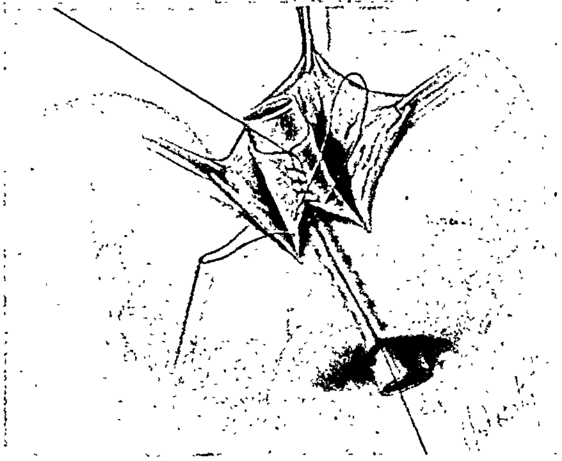


Fig. 4.

Fig. 1. Incision parallel to the lesser curvature; suturing of the seromuscularis over the rubber tube.

Fig. 2. A tunnel was formed by the approximation of the anterior stomach wall over the rubber tube.

Fig. 3. This illustrates the method used in the original operation. The whole serosa lined channel down to its base has been separated from the main body of the stomach. This procedure has been discarded, since it might endanger the blood supply to the terminal end of the pedicle tube; particularly so after its invagination upon itself. (See Figure 6 for comparison.)

Fig. 4. Suturing of the stomach mucosa over the distal half of the tube.

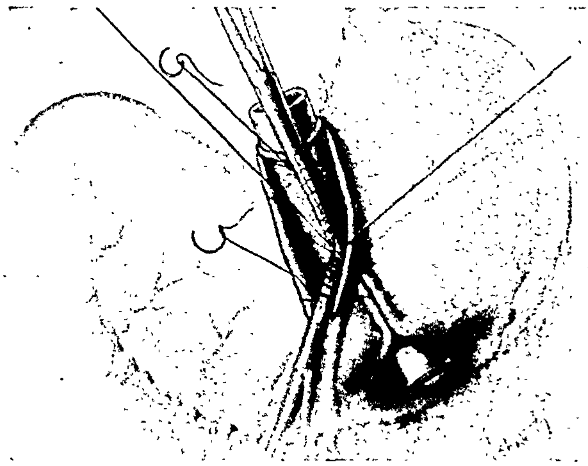


Fig. 5. Alternative method. The same is accomplished as in Figure 4, by suturing of the mucosa over the distal half of the tube between two clamps.

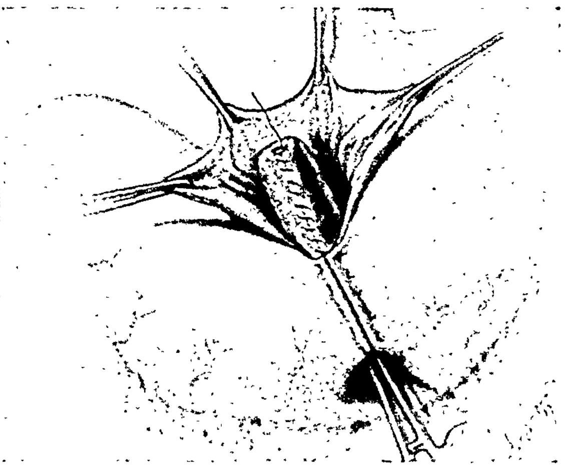


Fig. 6. The distal half of the tube is now free and is covered by stomach mucosa. The proximal half of the tube maintains its attachment to the main body of the stomach. Compare with Figure 3 which shows the original method now discarded.

semi-liquid and liquid. Recently, he vomited swallowed fluid and phlegm occasionally and felt a sensation of constriction which passed up from the lower sternum to the neck. The patient's weight had been 140 pounds. His present weight was 121 pounds. As this man had a slight secondary anemia, he was given a blood transfusion twice.

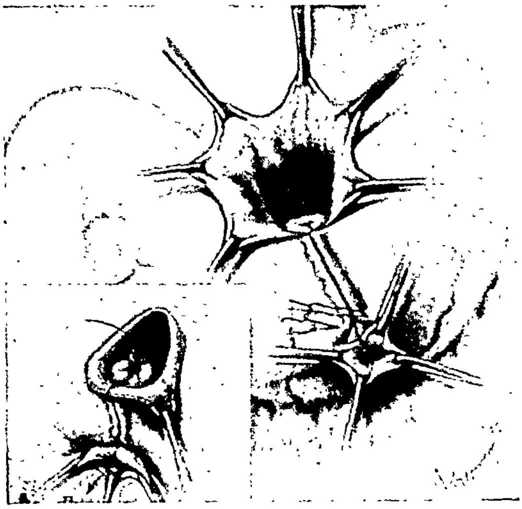


FIG. 7. The distal half of the tube has been invaginated through the serosa lined channel. The opening in the anterior wall of the main body of the stomach is closed by three rows of sutures (not shown in this illustration). Insert: *a*, the valvular gastrostomy is actually shorter than indicated in the main illustration.

Esophageoscopy on the following day gave the impression of a new growth just above the cardia. No biopsy was obtained. Exploratory operation was performed on October 21, 1942.

A left upper rectus incision was made. A gelatinous carcinoma was found which involved about one-third of the lesser curvature and also part of the abdominal esophagus. Distally, this growth extended to the posterior wall. The tumor was fixed to the posterior peritoneal wall and was considered inoperable because of its extension into the lesser omentum and fixation. There were no palpable metastases in the liver or omentum. A small part of the tumor was removed from the lesser sac for biopsy. The bleeding was difficult to control and was finally stopped by implanting and suturing a bit of rectus muscle to the bleeding area. About three-fourths of the stomach on the anterior surface was free from any growth. A gastrostomy was performed of the type picture in the illustrations. The patient made a good recovery. He was able to take food by mouth and tube three days following surgery. The patient has been seen on several occasions since the operation. He introduces the tube into the stomach through the gastrostomy opening during feeding time. No leakage has ever taken place through the gastrostomy opening.

Pathological report: Mucous cell carcinoma of the wall of the stomach with low grade inflammatory changes.

SUMMARY

A method of valvular gastrostomy is presented which has definite advantages over the original type recently described by this writer.

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THOMAS AQUINAS

INCUNABULA MEDICA VII

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TO Thomas Aquinas, physician, philosopher, priest, scientist, the most famous of the early religious philosophers, the greatest thinker of the thirteenth Century, modern medicine is deeply indebted. In his hands rested the medicine of the Middle Ages, and his carefully prepared translations and handwritten manuscripts transmitted down through the agency of the religious order to which he belonged, to be collected and later put into print as soon as the press was invented, formed the link between the medicine which had gone before and that which came after his time.

Essentially, he contributed nothing new to the ideas of the day as to medicinal practice, nor did he cause any upheaval in the prevalent medical thought. As the medicine of the time was in the hands of religious philosophers; and as philosophy and religion were considered inseparable, the speculations of these men in the realm of philosophy were closely tied to the field of medicine.

Only two "dicta" were announced by Thomas Aquinas medically and to these he adhered. They were not new and were but repetitions of what had been announced by others. One was that the body was formed by the junction of a material and a spiritual principle, that man consisted essentially of a spiritual mind united to a material body. The other was his belief in the "philosopher's stone," that for which all the scientists and philosophers searched, and which later was the cause of so much fraud and quackery in the centers of learning of the world.

Much has been written of Thomas Aquinas. In church history, of course, he is a shining light. To him is given credit for influencing the church's acceptance of the Aristotelean philosophy, and much of Aristotle's "De Animalibus" was interpreted by Thomas so that it would be acceptable to the proper church authorities. Pure religious history ascribed to him the performance of miracles and great cures, probably invented and built up as a sort of propaganda at the time of his canonization by the church.

He lived in the thirteenth Century, which has been called "the greatest of centuries" because it is believed that more was done for human progress by the men who lived then, than in any other like period in human history. Walsh, in his book on the period, states that it was the source of most that has seemed great and good since then, and that its intellectual achievement has not been surpassed in the seven hundred years since. Thomas Aquinas and Albertus Magnus, his teacher and master, were the outstanding personalities of the century; and as Thomas Aquinas is believed to have surpassed his teacher in his intellectual achievement, so his name stands as the greatest of the time. Henry Adams stated that the works of Thomas Aquinas represent more fully that point of history when man held the highest idea of himself as a unit in a unified universe. Apart from ecclesiastic writings, philosophic literature mentions Thomas mostly as a foundation stone, an interpreter, a pillar on which a whole school of philosophy depended. Medically, little has been written about him because of the fact, mentioned above, that he contributed no new thought.

Thomas Aquinas was born in Naples and came from one of the most ancient and noble families of royalty in Europe. He could have laid legitimate claim to the title of Prince. On his father's side he was related to the Emperor of Germany, Frederick I and the King of France, St. Louis. On his mother's side he was descended from the famous Tancrede who had conquered that part of Italy known as the Two Sicilies and had reigned over this region.

Situated between Rome and Naples, the city of Aquinas extended in the midst of a vast plain, the value and fertility of which was famous and to which the name "Compagna Felicia" or "Fields of Happiness" had been given.

In the third century, on a peak of bare rock his ancestors, the Counts of Aquinas, had constructed their castle, the castle of Rocca Secca, the ruins of which still exist to testify to their past grandeur. Its walls were extremely perpendicular and seemed to be a continuance of the bare rocks. Forming the foundation base of this rock ran the torrential river Melfo from the gorges of the Appenines. It was here that in 1227 was born the one who would forever make the name illustrious—in science and in religion—Thomas Aquinas.

The saintly religious side of his life has been much written of by ancient priests and modern. The scientific side, however, has been much neglected by his biographers.

Young Aquinas was very early confided to convent care to receive such an education as conformed to the desires of his parents. Fortunately, he was sent to a place known famously far and wide for its teaching and for its contributions to science, the Dominican monastery of Mont-Cassin. It was to this monastery that Constantinus, the African, had consigned to be preserved for following generations his great collection of scientific manuscripts and antiques. It was here that unabated work was carried on to extend the knowledge already gathered over the whole of Europe, and to add to this knowledge by laborious and tedious study and by translation and interpretation of the old classics. It was here that the word "benedictin" originated as a synonym for patient, untiring labor and devotion. Constant additions to the collection over periods of centuries had made the collection of scientific data at this monastery the most precious in all of Europe.

It was the custom of this celebrated monastery to receive a certain number of young men from the greatest families in Italy for the purpose of instruction and education. So to this fountain of knowledge Thomas Aquinas was apprenticed at the age of five years. He was accompanied by a governor who was charged never to allow the youngster out of his sight and whose duty it was to report to the parents daily regarding the health, studies, and activities of his charge.

The young student soon astonished his teachers by the rapidity of his progress, and they in turn found in him rare ability which they determined to develop. He devoted himself with tremendous ardor to reading, retreat and prayer, and study was his constant occupation. This was regarded as being truly remarkable for a child of his age.

"Teach me," he said one day to his teachers, "what God Himself is and all that He is, so that I shall love Him not because He should be loved, but because I am capable of loving Him." That he was indeed remarkable is attested to by the fact that very minute and orderly records of his residence were kept for posterity by the heads of the order and it is these records which furnish the biographical facts of his life.

After spending five years at the monastery he felt that he must have higher studies and of a different nature than those in the program outlined for him by the "Benedectins," and he is found writing to his father to allow him to leave the monastery and enter some university. The father did not believe that a child of ten years could possibly be equal to the task of studying the grand classics, but held a consultation with the superior of the abbey. The superior, in spite of his regret at having Thomas Aquinas leave, recognized the precocious talent in the boy and advised a great university.

It is said that there is in some men a quality of beauty which is like a ray of love and that Thomas Aquinas possessed this to the highest degree, even in childhood. He spoke little and he was habitually serious, profound and meditative; yet, although one saw no sign of humor one did not see signs of sadness in his face. His sympathetic nature was demonstrated by his charity to the needy in the country surrounding his home. When his small child's purse was insufficient for these purposes he demanded money from his parents for distribution to the poor.

After a short stay at home with his parents he was then sent to the University of Naples which was favored over the University of Bologna because of the patronage of the Emperor of Germany, Frederick II. The University was famous at the time for the ability of its professors and the quality of its students. At this time Naples was a city of luxury and dissolution, regarded as a new Babylon. The presence of Thomas here has been compared by his religious biographers to that of Daniel in the lion's den. However, he avoided all temptation, had no conversation with women and none with other students that was not directly concerned with study. His life was spent in attending the daily lectures and then returning to his room to study, to write, and to pray.

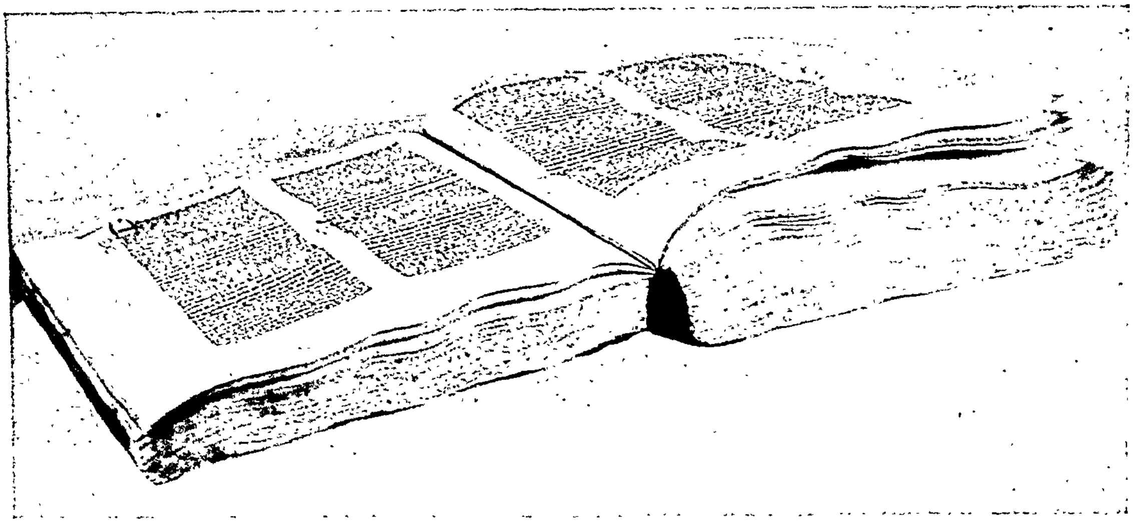

Fig. 1. Represents the first page of the "Catena Aurea," one of the outstanding works of the Angelic Doctor. It represents his work of adapting the doctrines of the Church to the philosophy of Aristotle and is considered as the work representing the highest development of scholasticism. This particular volume was printed in Basle, a free city of the Holy Roman Empire, by Michael Wenssler in 1476, who is considered one of the most distinguished of the early Basle typographers.

His charities continued in Naples and he became noted both for these and for his studies. His reputation began to extend far beyond the borders of the city. He was held up as a model for the students of the University and admired in the city as a model of modesty and charity.

At the age of sixteen or seventeen he decided to retire to a cloister. His fondness for study and the solitary life, coupled with his previous contacts with the friars of the Order of St. Dominic, plus the disorder and dissension prevalent throughout Italy at the time, decided him.

The Dominican fathers were celebrated far and wide for their preaching, their teaching, their example of virtue and their brilliant success in pushing forward throughout Europe, including Greece and into Asia, the boundaries of their provinces.

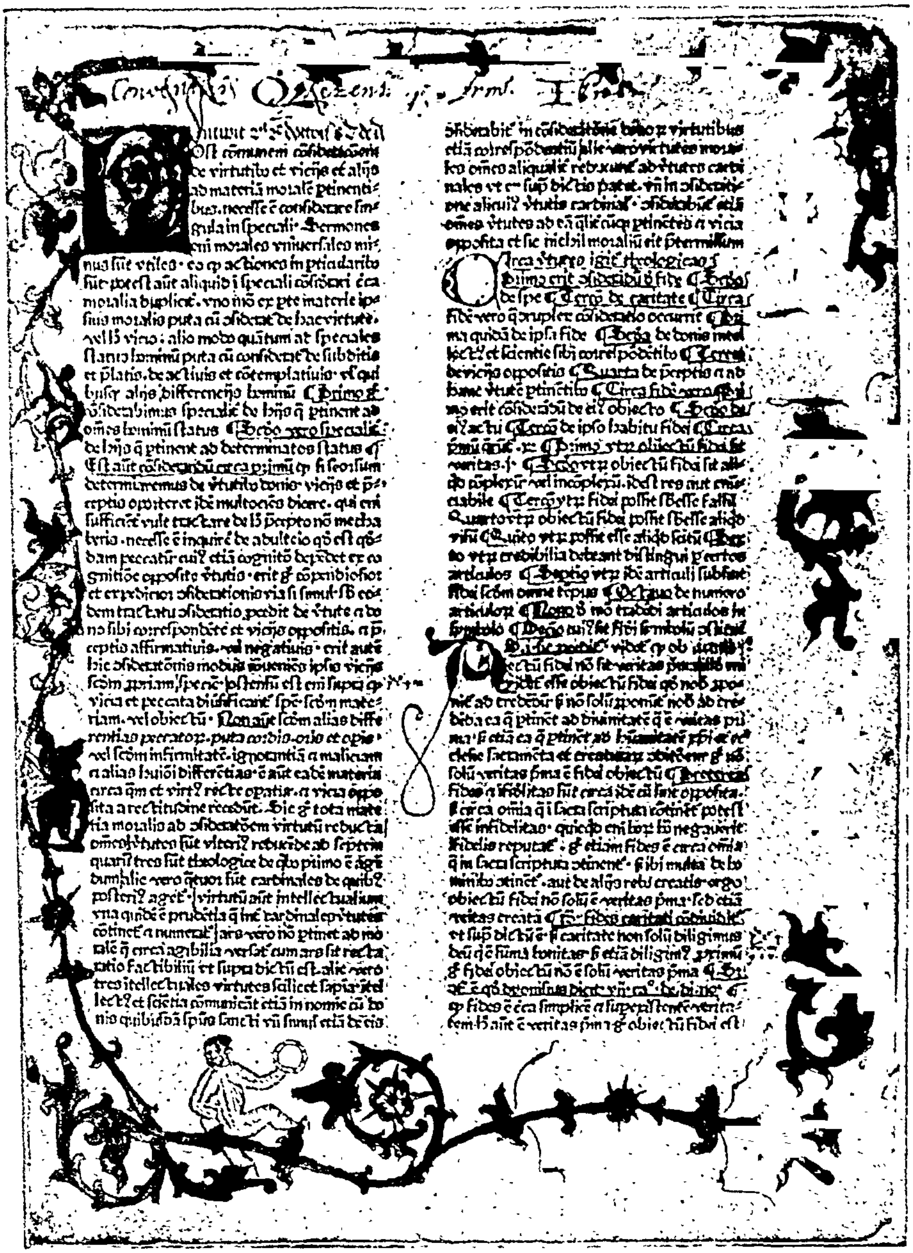

Fig. 2. Represents the first page of the "Summa Theologica" printed by Bonetus Locatellis at Venice in 1498. It is of interest to the bibliophile and collector in that no volume has appeared in any sale in the past ten years, and that it is not found in the majority of the large and noted collections of incunabulae. This volume represents the first printed edition of this work.

This extraordinary prestige and growth was due principally to the methods practiced by the order of instilling into the men among whom they found themselves the qualities of goodness, charity and equality. Above all, wherever the Dominicans established themselves, one saw quarreling ceasing almost as soon as they arrived. It was finally through the Dominicans that the Popes quelled civil riots and commotion in Europe. The rapidity of growth of this order was attributed to the fact that from its very beginning young men of the most illustrious families were sent there for learning. Among the aristocracy and elite the high and lofty concept of life was accepted as proper, in direct contradistinction to the nineteenth and twentieth century idea, which was to be the opposite.

Fig. 3. A photograph of the "Summa Theologica," showing the binding consisting of pages of incunabulae of the period pasted together to form thick boards. The back is of brown leather with curious markings. It was printed in Basle by Ruppel, a contemporary of Gutenberg's, about 1468.

Thomas Aquinas was completely subjugated, along with many others, by the prestige of the order and he declared that it was his solemn intention to take the Dominican garb and enter as a novice in a monastery. The Count Landulph, his father, and the Countess Theodora, his mother, received this news with despair. They used every means in their power to prevent their son from accomplishing this desire which was absolutely contrary to their wishes. In spite of their resistance, however, Thomas received the habit of the monks in the presence of all the order of that province. His mother had always nourished the hope of seeing her son elevated to one of the highest offices of the Church, but had never dreamed that he would voluntarily renounce the world and hide himself in the obscurity of a cloister. She could not foresee that the talents and virtues of Thomas would eventually spread far and wide throughout the provinces of the Dominicans. There was a possibility that sooner or later he might be called upon to play a great rôle in the world. It was also possible that by his teachings he could obtain an influence more widespread than would be possible for a high dignitary of the Church. But she did not reason thus; instead she resolved to journey herself to Naples and to do everything possible to drag her son away from the humility of a monastic life.

Thomas, on hearing of his mother's decision and of her journey to Naples, sought refuge in another Dominican monastery in Rome, the convent of St. Sabine, situated on top of the Aventin mountain and inhabited by the founder of the order. He made the journey secretly, accompanied by a few brothers of the order and took a different route from that which his mother would take to Naples. The Countess had also been informed of the route of Thomas' journey and, therefore turned about and arrived in Rome a few days after her son. There she begged, then threatened, in order to obtain an interview with him. The interview was refused by the superiors of the convent and the Countess filled the city with her complaints against the order.

In the meanwhile Count Landulph died, but the Countess, with her strong family connections and her relationship to the Emperor, caused no little trouble to the friars. The Dominicans judged it prudent, in order not to keep this battle flaming, to send Thomas to another monastery of the order. This time he went to a foreign land, namely, to Paris.

At this news the Countess was beside herself and her fury knew no bounds. Thomas had two brothers, Landulph and Reynold, who were in command of troops in the service of the Emperor of Germany, Frederick II, and who were at that particular time engaged in subduing Lombardy. The Countess, who kept these brothers constantly informed of family affairs, let them know that their younger brother was to journey by road to France in order to take his final vows in the order, and she ordered them to use every means possible to intercept him on the road and return him to her under suitable escort.

The mother's wish was punctually executed by her two militray sons. They placed a military guard on all roads by which it was possible for Thomas to enter France. By this time, however, Thomas had accomplished the most difficult part of his journey; he had crossed almost all of the Roman states and was on the point of entering Tuscany. He avoided with great care all cities, but if he found an abbey on the edge of a small town, which seemed hidden and safe, he asked for hospitality for himself and for the brother friars who escorted him. This was granted very readily.

Fatigued by a day's journey, Thomas was seated with his companions resting just outside the city of Aquapendente, when he looked up and saw approaching a mounted army troop fully armed. The young novice had no idea of engaging in any battle and surrendered without resistance. When the commander of the troops approached, he saw that he had been taken prisoner by none other than his brother Reynold, faithful executor of his mother's orders.

Reynold, however, was inclined to step a bit farther than his mother's instructions, so that after capturing his brother, he tried to tear from him by force his Dominican habit. He resisted his desire to do further damage because he did not wish to expose his brutality to his brother before his soldiers. In his partially torn habit or robe Thomas recrossed with his brother's military escort the same territory he had just negotiated, and was returned to the family home. The Countess, overjoyed to find herself at last in possession of her son, whom she loved with all her heart and soul, embraced him and covered him with kisses. Thomas was much affected and responded effusively. Serious conversation was deferred to a later time.

The Countess Theodora neglected no means in her power to make her son change his views in regard to the monastic life. Her plea is quoted as follows: "It is not with any purpose to swerve you from religion that I oppose with all my power your decision while you are yet too young, to imprison yourself in a cloister. Far from it. I flatter myself that sooner or later, thanks to your personal qualities, to your excellent education, to the illustrious name which you bear, and to the friendship with which the Emperor honors our House, you will come to be one of the great dignitaries of the Church, and I live in this sweet illusion. But you say you have made your decision. Without recounting to you what you owe to your ancestors, to their titles, their exploits, their glory, to their illustrious connections, to you, yourself, to your mother who should have some rights to your respect, your affection, or at least to your recognition, you desire to enter this order of preaching friars or beggars without consulting anyone. So then, I entreat you, you cannot enter such a state without slurring your family, without detracting from the glory which your brothers Landulph and Reynold have acquired at the head of the armies of the Emperor.

"No, I could never allow that a descendent of our illustrious ancestors should hide himself in a cloister, that he should partake of the food, the clothes, the mode of living of the poor, that a young man with a nature, an education such as yours, should hide it in the shadows of a monastery. To satisfy a whim of which you would later repent, to contract a vow which binds you for your entire life, to accomplish an objective, something perhaps good in itself, but for which it is possible to substitute a better one, would you, therefore, willingly cause the death of the one that gave you life? If, while my two oldest sons expose themselves daily to the terrible hazards of war, my youngest son wishes to abandon me, what is there left for me except the grave?"

These words, accompanied by many tears, by evidences of a vital love and tenderness for him, were the basis of the plea made daily by the Countess. The efforts of Thomas to resist these entreaties of his mother caused him great pain, but he remained obdurate. In spite of the passionate discourses of his two sisters and their pleas, which were added to those of the mother, he remained unchanged. He then reversed the situation and preached to them to justify his decision. He mentioned that the peaceful and solitary life of the cloister was that which conformed mostly to the teachings of God. He painted a picture in words of life in a convent so beautiful and so pure that his sisters were convinced by him. They were on the point of resolving to renounce the world themselves if this preaching had continued longer. Following this it was seen that nothing could be accomplished to change his decision so they ceased to oppose him.

Master of his time in the chateau, he confined himself to his habit of study, meditation and prayer. He was unaware the he was not entirely free, and unaware of the resistance which he would encounter as soon as he tried to leave.

The days went by, and Thomas did not tire in spite of his captivity; his brothers finally arrived and found their mother mentally sick and worried. The two officers considered it an affair of honor for the family to make Thomas renounce his decision. As long as good treatment had not prevailed these military minded brothers decided to use other means. Partly by trickery and partly by force, they tried to obtain possession of Thomas' religious robe but Thomas repulsed them with indignation. A fight ensued and the robe was torn to shreds. Vanquished in this unequal struggle, Thomas was confined in the tower of the chateau. Here he remained a prisoner and nothing was neglected to make his confinement a difficult one.

Recognizing that ill treatment was not succeeding in conquering the resistance of Thomas, his brothers adopted other measures. There had arrived at the chateau, probably at the suggestion of their mother and sisters, a very beautiful courtesan, whom they shut up with Thomas. This was perhaps the most dangerous assault which could be made against his youth, but his good resolutions and his virtue triumphed over this method. In order to cut short the situation in which he sensed peril, he seized a hot fire-brand and used it on the fair beauty, who fled with cries of pain. With the same brand, instrument of his victory, he traced a large black cross on the wall of his prison cell and began to pray. At last, exhausted by the effort of this unexpected combat, he fell into a deep sleep. Another plot had been frustrated.

His detention lasted more than a year, but in the meanwhile Thomas had established communication with the heads of the Dominican Order through the intermediary of his sisters. More than once a Dominican was secretly let into the tower. The heads of the order then seized upon a golden opportunity. The Pope and Emperor were on good terms, which was not often the case. The Dominicans devoted themselves to the interests of one and the justice of the other, but at the same time pleaded with both to free Thomas from his imprisonment.

The Pope was highly indignant on learning that the Emperor's soldiers had dared to chain a "religieux" in the land which was under his authority, and on the other hand the Emperor was highly indignant that this should have been done without his knowledge. He ordered the immediate arrest of the two Counts Aquinas and threatened them with severe punishment if their brother were not liberated at once.

So it became necessary to render unto religion the hero which she claimed. His mother wrote to the head of the Dominicans at Naples, asking him to send to the chateau of Rocca Secca two friars, to whom she surrendered her son. She insisted, however, that his departure from the chateau should be in her own bizarre manner, in order that it might not appear that she was agreeable. The three Dominicans arrived from Naples, waited at the foot of the tower which had served at Thomas' prison. His two sisters at a window had him enter a wicker basket suspended by cords which they held. In this manner he was let down from the top to the foot of the tower into the arms of the Dominicans, "as an angel descended from Heaven." Everything was made to appear as if an escape from the chateau had taken place.

Thomas thus left his ancestral home to enter into the service of God. The object of the Countess in ordering her son to leave the castle in this strange fashion has not been explained, but probably it was pure whim or caprice.

The Pope, wishing to judge for himself of the fitness and ability of Thomas, ordered that he should be assigned to Rome. The Countess Theodora and the two Counts Aquinas accompanied him in order that they might offer explanations and receive absolution from the saintly father for their deed. The Pope interviewed Thomas and after careful consideration decided that he would be allowed to take his vows but only after a probationary period of six months as a novice under the watchful eye of the Pope himself.

It was through the superiority of talent and learning of the members of their order that the Dominicans exerted their greatest influence. The position of their families and the connections from which their members came also made the order powerful. The heads made it a point to attract as many young men of talent and ability as they could discover in the top steps of society. The ability and personality of Thomas Aquinas came to their notice at a very fortunate time and they devoted themselves to develop his talent to the highest degree possible. It was decided at a meeting of the Grand Council of the Order that Albertus Magnus himself should be charged with the religious and scientific education of Thomas.

The General of the Dominicans, therefore, left immediately for Paris with Thomas. After spending several weeks there, they proceeded to Cologne where Thomas was placed in the hands of Albertus Magnus himself.

In 1245, he was again in Paris, following Albertus Magnus there, as the illustrious Dominican had been called to give a series of lectures at the College of St. Jacques. In the midst of the youthful turbulence of the University of Paris Thomas Aquinas, whom Dante in his "Divine Comedy," places at the head of the philosophers of his time, attracted considerable attention because of his taciturn manner and his almost savage-like hypnotic behavior.

He listened with extreme concentration and attention to all of the lectures of the master, Albertus, but if he found himself in the midst of a discussion after a lecture he would never utter a word. To a direct question he would respond laconically, in such a manner that considerable doubt existed as to his extreme wisdom and great talent. He had no desire to associate himself with students of low morals and his general deportment and manners were in direct contrast to the usual habits of students in Naples. His silence was of such extreme degree, that he was wrongly judged; this voluntary silence was thought to be a screen for stupidity and he was given several uncomplimentary nicknames: the deafmute, the Dumb Ox, the Great Ox of Sicily.

Albertus, hearing whisperings and being aware of what was taking place, decided to assure himself as to the progress of his pupil. One day in the presence of his fellow students he asked Thomas many questions, none of which were easy nor were they possible of answer unless one were prepared and had actually studied. Thomas, however, replied with such reasoning and wisdom and evidence of profound thought, that all of his auditors, not even excepting Albertus himself, were astonished. Albertus, addressing himself to the others, made a prophetic admonition: "You call him the Dumb Ox, but this ox will carry on such a bellowing as will be heard and heeded throughout the entire world."

In 1248, Thomas, having finished his studies, left Paris and returned with Albertus Magnus to Cologne where he was ordained. From this time on his relationship with Albertus was no longer that of student and professor, but that of friends in whom existed a reciprocal affection and devotion.

Thomas often in his writings expresses his recognition and his admiration for Albertus. He goes so far as to call him his Divine Master. In one of his books he advises, "Follow then the divine Albertus Magnus, my teacher." He also says: "If you have constantly before you the rules given you by Albertus, you will have no need of seeking the great nor the royal, but the great and the royal, on the contrary, will seek you out."

In spite of his liking for constant seclusion, Thomas, obedient to the wish of his superiors, was obliged to devote his time to preaching and teaching, the fundamental objects of the Order of Dominicans. But although he preached and gave lectures in theology, he did so solely for instruction and not for enjoyment. It is said that he acquired such an easy style of diction and language that in composing his works it was possible for him to dictate to three or four secretaries at the same time and on as many different subjects.

In 1252, he was went to Paris to give some public lectures on his way to Rome to be promoted in the Order. The examinations for promotion were difficult in those days and consisted of a number of audiences at which a candidate was required to demonstrate his special fitness and aptness in teaching and expounding theology.

As a result of these examinations he became a Professor in the University of St. Jacques; although he was still quite young he was from the very beginning classified among the most learned professors at a time when the faculty consisted of many men of outstanding ability. The Pope, Alexander IV, at the time of his examination, noted and admired the calmness and moderation of Thomas, who, always master of himself, confined himself entirely to repudiating the opinions and facts of the opposition without ever indulging in personalities and not once replying to the words and insinuations of his adversaries. He simply cited his reasons and opinions with gentleness but firmness. He remained in Rome until 1255, then returned to Paris. The favorable impression that he had left behind him in Rome prompted Pope Urban IV to recall him to Rome. He was given the task of preparing to institute the "Feast of the Holy Sacrament." At this time Thomas composed a poem, "The Lauda," some other verse, and the hymn, "Adoro te."

He did not return to Paris again until 1269 after the death of Pope Clement IV. This Pope had named him Archbishop of Naples, but desiring to be only a simple priest he had refused this honor. He had also refused the directorship of the Abbey of Mont-Cassin which had been offered him by Pope Innocent IV.

One day he entered the private chamber of this Pope while he was counting a very large sum of money. "See," said the Pope, "the Church no longer belongs to the time when she could say 'I have neither gold nor silver.'" "It is true, Holy Father," replied Thomas, "but also she cannot say to the paralytic, 'Rise and walk'." The pious Dominican had pushed aside all earthly ambitions and was able to reply so freely to the supreme chief of the Catholic faith.

During the time Thomas was in Paris, King Louis, who held him in great esteem, often invited him to the palace to dine. It was with considerable distaste that Thomas tore himself away from study and seclusion, but he had a marked respect for the King, and it was out of pure deference that he accepted these invitations.

He was not indifferent to the true manifestations of esteem which he received from persons of honorable character. During a mission which he was entrusted with at Louvain he was honored by the Duchess of Brabant, a brilliant woman who appreciated and loved to associate with men of talent and ability. The Duchess was charmed not only by the modesty and extreme simplicity of Thomas but by his vast amount of knowledge.

In spite of his extreme simplicity, there was in the carriage of the celebrated Dominican a true distinction. He was tall, extremely pale, with a deep forehead and shaven head. He suffered considerably from violent stomach cramps, which were probably due to his extreme fasting and the constant meager diet of his own choice.

In 1272, he was again in Naples teaching theology. Two years later Pope Gregory x invited him to go to Lyons to take part in a conference which had for its object uniting the Greek Orthodox and the Roman-English Churches. He was feeble and sick, and expressed a desire to see his niece before leaving Italy for France. At her home he fell ill and in a few days the illness assumed alarming proportions. Feeling that his end was approaching, he asked that he be taken to a nearby abbey where he died March 7, 1274, at the age of forty-eight years. There is a story which still exists in Italy that the great theologist had been poisoned while en route, by emissaries of Charles II, a prince noted for his crimes.

Thomas was canonized as a saint by Pope John XXII in July, 1323. The Church also named him "the patron saint of schools."[2]

When the University of Paris learned of his death they hastened to write to the head of the Dominican Chapter at Lyons, asking for his remains for burial. It is not recorded what reply the Dominicans made to the University, but the friars of the abbey refused to surrender possession of the body. It was not until 1369, under Pope Urban v, that the remains of Thomas were moved, ninety-four years after his death. After considerable strife between the Dominicans of Naples and those of the French monastery in Lyons, feeling was so high that the Pope judged it expedient, in order to ensure the safety of the body, that it be sent to a Dominican convent away from Italy. He designated the monastery at Toulouse to receive the precious remains. First, however, parts of the saintly body were distributed to different places considered consecreated because he had at some time dwelt there or had added to their glory. Thus the right arm of the doctor-saint was deposited in the Convent of the Dominicans in the Rue St. Jacques in Paris where he had written so much. The other hand was deposited in the Convent of Salerne in the city of Naples.

We arrive at an examination of the scientific works of Thomas Aquinas. His complete works consist of not less than seventeen volumes. Two volumes were entirely scientific, twelve volumes were on philosophy and the remaining three volumes on theology. His teaching and objective was the same as that of Albert the Great, whose pupil and friend he was. Demonstrating the existence of God by describing the harmoniousness of the assembling of the world in its creation and by founding the studgy of theoloy upon the study of nature, his scientific experiences, observations, and reasoning were the result of this work. The greatest part of his theories, dogmas, material, etc., was derived from Aristotle, Galen and the Arab, Avicenna.

The physics of Thomas Aquinas was only an exposition of that of Aristotle, as Thomas himself admitted. He added only long commentaries of his own in his "In Octo Libros Physicorum Aristotelis Expositio." He made considerable studies on the theories of force and the laws of motion. He believed that the extremely exact harmonious adjustment that existed between all things and all beings, this unity of plan which we see in the whole and even in the minutest details, made it necessary to presuppose a supercentralized direction, without which these conditions of order and harmony, this coördination of movement, these fixed and permanent laws of motion and force could not exist. In those times, such conditions and laws, as well as the observations and commentaries upon them, though purely metaphysical, constituted the realm of science and philosophy. It was, however, by speculation and through the collection of facts that science progressed. Thomas' commentaries on thirteenth century astronomy helped to advance toward the sciences of physics and chemistry as they are known today.

In his book on meteorology, a work of considerable size, he speaks not only of the varied phenomena of the atmosphere, but about comets, shooting stars, etc. His observations, of course, were not entirely correct, but it should be taken into consideration that he was somewhat handicapped in the means available to test out any of his theories. The sciences of physics and mathematics were also not sufficiently advanced at this time to give him help.

Another of his books, "The Nature of Minerals," merits attention. He mentions here the possibility of the manufacture of artificial stones, and he states that it is possible to imitate precious stones to such a degree that experts can be misled. He indicated the methods by which imitations of sapphires, emeralds, rubies, and topazes might be made. "Poteris quemlibet cristallem diverso modo colorare."

Throughout all of this scientific work, experimentation and speculation there was one objective only in the mind of Thomas Aquinas—to create a firm and solid foundation upon which to develop a true dogmatic theology; to this he devoted twelve volumes. It is not to be supposed that his "Summary of Theology" was an immense collection of mystical ideas, of superstitions, dreams, or of reasoning without any definite object. One finds a volume "The Metaphysical and Moral Order," devoted almost exclusively to material things, but the mere shutting out of metaphysical phenomena cannot deny the existence of such.

Theology had for its object the study of different observations from the standpoint of metaphysics, morals, intellect, and the allying of these objects or observations with a primary cause, God.

It is said that if his "Summary of Theology" were to be studied by philosophers without religious prejudices, from the standpoint of a non-biased philosophic study, it would be found that these volumes were the result of a very profound reasoning and careful observation and study, rather than just a collection of purely metaphysical speculations and comets.

There were two Thomas Aquinases, the one of the Church and the one of Science, the legendary person and the historical person.

The Church of Santo Dominico in Naples is situated near the University and is one of the richest churches in Naples. Of its numerous chapels two are dedicated to the "Patron Saint of Schools." In one of the chapels St. Thomas in a marble bas-relief is shown at the moment when, according to Catholic legend, Christ appeared to him to thank him for having written his "Summa Theologia" and is saying these celestial words into his ear:

"You have written well of me, Thomas." Underneath, almost invisible because of age, are three heads surrounded with halos, those of Christ, Thomas, and Mary.

In another chapel, more richly ornamented, considerable gold being interspersed with the marble, are two magnificent tombs, one superimposed on the other. These are supposed to be the tombs of Thomas' two brothers, the two hard brothers who tried by force to keep Thomas from his saintly destiny. There is also in the same chapel the tomb of Thomas' sister, who, converted by his example, also entered a convent and chose a religious life. Many valuable paintings done by Italy's masters through the later centuries, depicting various events in the life of the Saint, form the walls of this chapel.

In the sacristy of the church in a silver frame, one sees a page of lines written by the hand of Thomas. Adjacent to the church is the monastery of the Dominicans of Naples, where Thomas spent so much time in study, meditation and prayer. Today the cloister of the Dominicans is used as a municipal school by the city of Naples. Such is the inevitable march of progress. Monuments to science, religion, and history fall before the economic needs of modern society.

Osler, in his "Incunabula Medica," does not list any of the works of Thomas Aquinas, although in his summary of thirteenth century medicine he mentions him.

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INJECTION treatment is a most valuable method for the cure of varicose diseases. Increasing experience has, however, more clearly defined its usefulness and limitations. Injections are likely to be successful and effective when the varicose condition does not extend above the knee, when there is no incompetence of the main internal saphenous vein in the thigh, and when the veins to be treated are relatively tortuous and thin-walled.

The brief excerpts in this issue have been taken from "Minor Surgery," edited by Humphry Rolleston and Allan Moncrieff (Philosophical Library).

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Editorial

APPENDICITIS IN THE TROPICS

EXPERIENCES IN A U. S. NAVAL BASE HOSPITAL

THE necessary emphasis on war wounds and tropical diseases at a large Base Hospital near the front, may make one forget such a common surgical condition as appendicitis. In the past year, at one of the Navy Base Hospitals in the South Pacific area 1,768 operations were performed; 316 were abdominal procedures and of these 41 per cent were for appendicitis. There was, therefore, an appendectomy performed every 2.8 days.

Appendicitis is by far the most common emergency condition requiring abdominal section, even in the war zone. While appendicitis may develop at any age, it is *primarily a disease of adolescence*. Fifty per cent occur between the age of five and twenty. The reason for the selectivity for this age is partly anatomical. After the age of forty, the appendix begins to atrophy and becomes obliterated. Up to the age of five, the appendix is relatively large in size and permits adequate drainage. The similarity of enviroment, food and types of infections results in a familial factor, many times members of the same family having operations for appendicitis. This applies also to men aboard ships or to troops in the field. During the time the Marines were training for both the Bougainville and Gilbert Island invasion, we had a high appendectomy rate. In each of those two months there were three times more operations for this condition than in any other month of the year. This increase was due to the temporary influx of young troops living under similar circumstances and dietary regimes.

All surgeons have noticed a difference in the severity of appendicitis in children and in adults. One-half of the appendices removed in infancy are ruptured. This diagnostic delay is partly due to children's inability to describe symptoms and the still prevalent idea of giving cathartics for so-called colics. Poor mastication of food and neglect of bowel habit also may be a factor. There is also a difference in the rapidity of the pathological change in this condition in winter and in the summer. At home we have associated this difference with the fact that children are out of school, off schedule and consuming larger and various amounts of liquids. These may be important factors.

Appendicitis, at any rate, in the tropics, may run as rapid a course as it does in children in the summer at home. The soldier or sailor is young and often does not wish to complain, thus masking his symptoms. He fears to lose contact with his outfit and friends, to be left behind. He has been told about hookworm, dysentery and malaria, all of which have abdominal symptoms; and he may assume the abdominal discomfort is due to one of these. With the heat and humidity a large quantity of liquids, such as, cold drinks, beer, carbonated waters, and fruit juices of all types, are taken, all of which have the effect of increasing peristalsis. At rare times, irregularity of eating may have an effect. In many, the promiscuity of the toilet causes the development of a chronic constipation. All or any combination of these factors may be the answer, but we have been aware that appendicitis in the tropics is more severe, more rapid in its progress and with a greater tendency to gangrene than in other climates. Some of the difficulties in diagnosis will be enumerated.

The diagnosis of appendicitis can be made by the history. If it is typical, appendectomy is indicated. Even if it is not typical, appendicitis cannot be eliminated. The typical history, as described by J. B. Murphy, is a colicky pain of a general, epigastric or naval type followed by nausea, the nausea frequently resulting in vomiting one or more times. Localization later will occur in the right lower quadrant with tenderness. Murphy added fever to the above three, as a prerogative for diagnosis, but we will show that fever is not only not necessary but more often is absent. With such a history appendicitis will be correctly diagnosed in 95 per cent of the patients. A different history is usually due to previous attacks. A typical history was given in 65 per cent of the last one hundred appendectomies performed here. Fifty-one per cent of our patients gave a history suggestive of a previous attack. Many of the other classical aids to the diagnosis are not applicable. *Constipation* accompanies appendicitis in the majority of instances but in the tropics this rule does not hold. One out of every five of our patients with appendicitis had diarrhea. The *temperature* rise of one to three degrees, which we expected, frequently is not seen. The average admission temperature of our patients was 97.3°F., only 10 per cent were above 99°F., and only 1 per cent had a high fever, 104°F. The pulse rate, frequently an excellent guide to infection inside the peritoneum, was not a diagnostic help. We have heard surgeons make the remark that if the pulse rate was not elevated the patient did not have appendicitis. The average pulse rate of one hundred patients, with appendicitis, on admission to this hospital, was seventy-seven and eighty-two of these patients had advanced appendiceal disease.

We have been impressed with the abnormal blood counts, especially the white counts that are reported in this area. Babcock states that in appendicitis the white count of 9 to 18,000 will be early and associated with a 70 to 85 per cent polymorphonuclear cells. The average count in these one hundred patients studied was 11,714. This seems high but the count of forty-three of the patients was below 10,000 and the few with counts of 20 to 25,000 raised the average. The percentage of segmented forms also was low, the average being 58.5 per cent in contrast to the expected 80 per cent. This figure, though actually low, is relatively a mild increase as the percentage of segmented forms in a control group was 54. The number of band forms which averaged 6.5 per cent gave some indication of the activity of the process. It is apparent then, that the laboratory is even less helpful to us here in diagnosing appendicitis than it is in the States.

In analyzing the degree of severity of the disease we found 5 per cent were ruptured, 41 per cent were gangrenous, 39 per cent were acutely inflamed and only 15 per cent were considered mildly or chronically inflamed. This finding of nearly one-half, either ruptured or in a preruptured state, argues, if any argument is needed, against procrastination for more diagnostic data. Delay is still our greatest problem. Perhaps more emphasis should be placed on training of both the servicemen and the corpsmen to be on the watch for appendiceal symptoms. The best opportunity of obtaining the patients for operation early should be in men under military discipline. Yet our patients were seen on the average of twenty-seven hours after the onset of the symptoms; 51 per cent were seen over twenty-four hours after the symptoms began and 31 per cent only after forty-eight hours had elapsed. This figure should have been materially lower and perhaps could be decreased by correct instruction. At times, transportation and weather interfered with early operation and a few were seen where operation had been delayed at sea. Thirty-two per cent were seen in the first twelve hours and this compares favorably with the one-third seen in the first twelve hours in the report on appendicitis in a U. S. Hospital.

The desire to avoid delay does not mean that appendectomy by untrained men is preferable. Where conditions or personnel are not ideal for appendectomy, the Ochsner type of treatment with the addition of sulfa drug is indicated. Occasionally, of course, a normal appendix will be removed for gastro-enteritis or renal colic. If the appendectomy is performed by a trained man, there will be no ill effects from such a procedure in 299 out of 300 times. The effect of the error in judgment on the other hand, of course, would be serious. The man with pain in his right side should be considered to have appendicitis until proved otherwise. There were no deaths in this series.

Certain technical points in the operation for appendicitis are interesting. To most of us in private practice, spinal anesthesia is the anesthetic of choice, and in the service it is used practically exclusively. It was used 625 times in the past year at this base. It is rapid, safe (one death in over 7,000) and by producing a negative intra-abdominal pressure, eases the technical removal of the organ. The second anesthetic choice should be local infiltration. Five hundred seventy-four operations, of all types, were performed here in a year with this method. A local anesthetic is ideal if the anatomy of the area is kept in mind and if it is remembered that only that part injected is numbed. One cannot "hit" the patient with instruments, pull roughly on mesentery not infiltrated, or use rough or coarse instruments. A gentle technic is necessary for a local anesthesia success. Art as well as science is helpful in both local and spinal anesthesia and is worthy of a note. The patient is awake, apprehensive, and aware of all words and actions of the operating team. The comfort and lack of pain of the remainder of the body must be observed. Cramped and uncomfortable positions must be avoided. Pressure from instruments or the assistant's hands must be eliminated. Tension on or torsion of organs innervated beyond the anesthetic zone must be avoided. An entirely different technic stressing gentleness, smaller and more delicate instruments, needles and sutures and most important of all, the light hand, must be developed. This regime must be extended from the operator to every assistant or nurse. A general anesthetic frequently creates a false sense of security, even, of roughness and obtuseness in the operating room. The fact that the patient is unconscious permits even levity at times and strict discipline frequently relaxes when the difficult technical part of the operation is completed. In the use of local or spinal anesthesia, no such situation can endure. Shop talk, rough, though surgical language increases the already high degree of apprehension, and the banging and brandishing of instruments may play their part in destroying the cooperation of the patient on which surgical success depends. The use of music in the operating room to distract the patient has a sound psychological basis. A considerate voiced individual at the head of the table, who reassures the patient, is also of value.

In the service it is difficult to see much use for an inhalation anesthetic, and certainly in the tropics these other two should be sufficient in the great majority of instances. Of the others, sodium pentothal is more effective than ether, especially in the tropics. Four hundred thirty-seven intravenous anesthetics were given last year. Inhalation gasses have not been available in this area.

The muscle splitting incision of McBurney or others will be effective in most cases. A transverse skin incision in the line of skin cleavage improves the scar. Personally, we found it better to place the incision higher than the classical site because the difficult appendix is usually the high and retroceal one. Further, the incision can be extended down better than up. When there is a diagnostic doubt, the right rectus incision is used. The so-called adequate incision (meaning large) and the small incision have their advocates. If the diagnosis is correct and it is possible to remove the appendix through an inch incision, we believe the patients do better, mainly because a small incision precludes the handling of the organs and spreading of the localized process.

The same difference of opinion exists between the inverters and the non-inverters of the stump, although we believe now that most surgeons do not invert. Cultures of the needles used to invert the appendix base will grow colon bacilli in 30 per cent. It follows that unless there is gross contamination, the peritoneum is able to care for the mild infection. Technic can make this contamination minimal. Care in retracting can prevent the stump touching the viscera or wound edge until the cautery and the tying of an adjacent piece of mesentery over the stump effectively seals it off. The changing of retractors and instruments in closing, from those used in removing the appendix is a minor point which helps prevent contamination.

When to drain is still a problem to many. The advent of sulfa drugs brought certain ill prepared publications which confused the picture. Certainly, clear or turbid fluid requires no drainage. Gross fecal contamination, on the other hand, is an indication for drainage, as even large doses of sulfa cannot counteract feces in the peritoneum. A safe plan is to drain if there has been perforation or gross contamination, but not to drain if there is merely a exudative reaction. In other words, when the fluid is exudative and protective do not remove it; when it is a contamination, drain it.

In 37 per cent of our patients there was free fluid in the peritoneal cavity. Sulfa powder was inserted 23 times, and these with few exceptions, were in the more advanced state. The function of the sulfa powder locally is debatable. It probably acts by absorption as a very high level can be obtained early. Its presence, locally, does cause some exudate and perhaps its intraperitoneal application thus increases the local protection power.

If a drain is placed in the wound, it should be to the base of the appendix. Drains into the pelvis, etc., merely help fix an abscess and the abscess thus may be the result of the drain.

One other debatable point is whether and when to feed the patient. When the peritoneum is opened there is at least a temporary insult to the contents. Nature counteracts this by creating a temporary ileus—a process to permit localization of any inflammation. Immobilization of any inflamed part is a keynote in aiding localization. When localization is no longer needed, peristalsis becomes active. Efforts to cause peristalsis prior to the time it would occur spontaneously can have detrimental effects. Thus feeding too early, or the use of such stimulants as prostigmine can upset the balance between the resistance and the infection. The distention which is present can best be controlled by suction siphonage applied to an indwelling duodenal tube.

We conclude, therefore, that right-sided abdominal pain or tenderness should be considered appendicitis until proven otherwise. In the tropics appendicitis often is a more rapid and severe disease than in other climates. The history and right lower quadrant tenderness is the best diagnostic aid. The laboratory methods of diagnosis in this disease are not reliable. Spinal anesthesia is the anesthetic of choice; local infiltration is also of value. There is still too much delay between the onset of symptoms and appendectomy. Sulfa drugs, etc., will not replace judicious surgery, and when in doubt—operate.

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Original Articles

FUNCTIONAL PARATHYROID TUMORS AND HYPERPARATHYROIDISM

CLINICAL AND PATHOLOGIC CONSIDERATIONS

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Section I. Clinical Considerations

REVIEW OF THE DEVELOPMENT OF THE CLINICAL CONCEPT OF HYPERPARATHYROIDISM

ACCORDING to Denninger, osteitis fibrosa cystica existed in America in pre-Columbian times. The skeleton of a primitive American, unearthed in northern Illinois, revealed lesions which have been interpreted as those of this condition.

In 1877, Paget called attention to the disease which has since borne his name. This disease is characterized by the thickening and bending of bones of persons of middle and old age. In 1891, von Recklinghausen confounded Paget's disease of bone with osteitis fibrosa cystica generalisata by taking up the two conditions as subtypes of a common fibrocystic osteitis. However, the description of his Cases 5 and 7 was the first really valuable anatomic account of this disease of bone.

In 1904, Askanazy described the association of disease of bone with a tumor of parathyroid origin. Askanazy stated the disease of bone to be osteitis deformans but his description clearly showed it to be the generalized type of osteitis fibrosa cystica. This isolated observation attracted little attention. In 1907, Erdheim[26] described three cases of osteomalacia associated with parathyroid enlargement. This called forth many other observations of disease of bone associated either with hyperplasia or with formation of tumor in the parathyroid glands.

The teachings of Erdheim delayed the clinical recognition of the etiologic rôle of parathyroid tumors in generalized osteitis fibrosa cystica. However, in 1915 Schlagenhaufer, after finding at necropsy two cases of generalized osteitis fibrosa cystica associated with tumorous parathyroid glands, questioned Erdheim's hypothesis as to the compensatory character of the enlarged parathyroid glands and recommended exploration of the neck and removal of the parathyroid tumor, if found.

In 1925, Hoffheinz reviewed from the literature forty-five cases of enlarged parathyroid glands. Of the twenty-seven which were associated with disease of bone, seventeen showed generalized osteitis fibrosa cystica, eight showed osteomalacia and two showed rickets.

In spite of Schlagenhaufer's suggestion, it was not until 1926 that Mandl,[50] of Vienna, resorted to exploration of the parathyroid region in a case of generalized osteitis fibrosa cystica. He did this only when treatment by parathyroid transplants had failed. A parathyroid tumor was found and removed at operation. Considerable clinical improvement followed this operation but recovery was incomplete. Seven years later further lesions of bone and renal stones had developed. Mandl[51] reoperated but was unable to find further tumor tissue which he believed to be present.

Following Mandl's report, interest in the surgical treatment of hyperparathyroidism was aroused. In 1928, Gold reported a case in which hyperparathyroidism was treated successfully by removal of a parathyroid adenoma. The patient was a woman aged fifty-four years, who had generalized osteitis fibrosa cystica. There were cysts in the right humerus and in three ribs, and the left femur had fractured. The concentration of calcium was 13.1 mg. per 100 cc. of serum and there was increased excretion of calcium in the urine. A parathyroid adenoma was removed. Five months later, there were considerable clinical improvement and much less pain. The concentration of calcium was 9.6 mg. per 100 cc. of serum and there was a positive calcium balance.

In 1929, Barr, Bulger and Dixon[13] were the first in America to report a case in which osteitis fibrosa cystica was treated by operative removal of a parathyroid tumor. The patient was a woman, fifty-six years of age, who had giant-cell tumors of the maxilla, ulna and right forefinger and a spontaneous fracture of the clavicle. There was muscular hypotonia. Bilateral renal calculi were present and there was increased frequency of micturition. The concentration of calcium was 16 mg. per 100 cc. of serum and that of phosphorus was 1.4 mg. per 100 cc. of serum. Excretion of calcium in the urine was greatly increased. In the left lobe of the thyroid gland a globular mass the size of a walnut could be felt. A parathyroid adenoma was removed and two days after operation, tetany developed. The calcium balance became positive and the concentration of calcium fell to as low as 4.1 mg. per 100 cc. of serum on the sixteenth postoperative day, while that of phosphorus rose to as high as 11.2 mg. per 100 cc. of serum on the ninth postoperative day. Unfortunately, the patient later died with infection of the urinary tract and impaired renal function.

In 1905, MacCallum was the first to record the association of renal disease and a parathyroid tumor. His patient, a young man, died of uremia following nephritis. A parathyroid tumor was found at necropsy. In 1921, Hubbard and Wentworth reported a case of osteitis fibrosa cystica in which there were advanced interstitial nephritis and hyperplasia of the parathyroids.

The association of renal calculi and disease of bone was first noted by Davies-Colley in 1884. He described the case of a girl brought up in a cellar. A disease of her bones developed before the age of nine years. This was characterized by swellings in the jaw, ribs and pelvis which may well have been due to generalized osteitis fibrosa cystica. There were extensive calculi in the kidneys and ureters. Davies-Colley also noted in this case an increase of the urinary excretion of calcium and a decrease of the urinary excretion of the phosphate radical.

In 1907, Gaugele described a case of osteitis fibrosa cystica in which the patient died of uremia. The kidneys contained sand and stones which had produced hydronephrosis and pyelonephritis.

In 1912, Jacoby and Schroth found an abnormally high excretion of calcium associated with generalized osteitis fibrosa cystica. In 1926, Mandl[50] found that the increased excretion of calcium in the urine of his patient was reduced to a sixth of the preoperative level by removal of the parathyroid adenoma. Subsequent studies by Gold, by Wilder and by Boyd, Milgram and Stearns established an abnormally high excretion of calcium in the urine as a constant feature of the disease.

In 1928, Gold recorded the finding of an increased calcium content of the serum in his case of hyperparathyroidism. The subsequent reports of Wilder and of Boyd, Milgram and Stearns corroborated this finding. DuBois and Aub and Boyd, Milgram and Stearns were the first to record hypophosphatemia in clinical cases of hyperparathyroidism.

The cystic lesions of bone and the bony deformities of generalized osteitis fibrosa cystica were recognized by roentgenologic examination before their full significance in the pathologic picture of hyperparathyroidism was realized. However, in addition to the cystic lesions and deformities, Camp and Ochsner, in 1931, described a characteristic type of generalized osteoporosis encountered in some cases of hyperparathyroidism. The roentgenograms of the bones, particularly the skull, showed a miliary or granular appearance. The trabeculae of the bone and the cortical bone appeared thinned and regions of subperiosteal absorption were observed in the long bones and phalanges.

Changes in the mouth in diseases of the parathyroid glands were first recorded in 1906 by Erdheim[25] in his early observations on the effect of these glands on the teeth. In 1934, Albright, Aub and Bauer[3] described the changes in the mouth in the case of the famous Captain Martell. This patient was known to have had hyperparathyroidism for thirteen years and underwent seven operations before the parathyroid tumor was located in the anterior mediastinum. The jaws were in marked malocclusion. The lower jaw was prognathous to such an extent that the entire mandibular dentition was in mesial occlusion. Several visible masses distorted the normal contour of the alveolar process. Roentgenograms revealed numerous punched-out regions resembling cysts. The entire mandible was osteoporotic and in sharp contrast to the well calcified teeth. The trabeculation of the mandible and maxilla was closely meshed and similar to ground glass in appearance. The lamina dura was absent from almost all the teeth. Despite this, roentgenographic examination revealed only one or two obvious cavities. The history revealed that in the patient's numerous stays in the hospital for thirteen years his dental attention had been limited to one or two temporary fillings and that his occlusion had been normal fifteen years earlier. The teeth were not loose and a specimen tooth was extracted only with considerable effort.

In 1941, Strock reported his study of the changes in the mouth in forty-five cases of hyperparathyroidism. He found tumors of the jaw in about half the cases. Prognathism, malocclusion and the formation of cyst-like cavities in the jaw were common. Roentgenograms frequently revealed osteoporosis and a ground glass appearance of the jaws. Dental caries was unusual and this in spite of the increased calcium excretion of hyperparathyroidism. To Strock the most striking finding, one for which he thought every dentist should be on the watch, was absence or partial loss of the lamina dura as seen in roentgenograms.

Since Mandl's report in 1926, there have been many reports of cases of hyperparathyroidism. In most of these cases the etiologic factor has been formation of tumor in the parathyroid. In other cases hyperparathyroidism has been attributed to parathyroid hyperplasia. In 1936, Wilder and Howell, accepting only cases in which the diagnosis of hyperparathyroidism was well substantiated, collected 135 cases reported since the date of Mandl's publication. However, in 1941, Cope was able to state that sixty cases of proved hyperparathyroidism had been encountered at the Massachusetts General Hospital alone. It has thus become possible to recognize different clinical types of hyperparathyroidism and the diagnosis can now be made without the classic picture of von Recklinghausen's disease of bone.

One clinical type has become known as acute hyperparathyroidism. This term has been applied to those severe cases in which acute fatal hyperparathyroidism, usually superimposed on the background of more chronic hyperparathyroidism, has developed.

In 1923, Dawson and Struthers gave the first clear account of an acute fatal illness in the course of a case which presented generalized osteitis fibrosa with parathyroid tumor and metastatic calcification. The terminal phenomenon was an acute syncopal attack with a rapid, feeble pulse.

In 1932, Lowenburg and Ginsburg described the results of the administration of an excess of parathyroid hormone to a boy aged five years. He received 100 units a day in error. On the second day he began to vomit and became listless. On the fourth day extreme mental depression had developed and there were fever and tachycardia. These became more severe until on the sixth day the error was discovered. The concentration of calcium was then 19.6 mg. per 100 cc. of serum. Rapid recovery followed withdrawal of the drug.

In 1939, Hanes described a case in which there was a five-year history of hyperparathyroidism with changes of bone and metastatic renal calcification. While awaiting operation the patient became weak and mentally depressed, fever and tachycardia developed and she died before operation could be performed.

In 1939, Oliver described two cases of death from hyperparathyroidism. The prominent clinical features were vomiting, anorexia, loss of weight, asthenia, constipation, mental retardation and thoracic pain. Fever, drowsiness, tachycardia and elevation of the concentration of urea in the blood preceded death.

In 1940, Smith and Cooke described the fifth case of acute hyperparathyroidism to be confirmed by necropsy. The patient had a two-year history of limping, pains in the leg and constipation. Abdominal pain, vomiting and tachycardia then developed. Delirium, abdominal distention and elevation of the concentration of urea in the blood preceded death.

CASE REPORTS—CLINICAL

A study of the case records of the Mayo Clinic up to November, 1942, revealed fourteen cases of hyperparathyroidism due to formation of tumor in the parathyroid glands.* The cases have been numbered in the chronologic order of the appearance of the patients at the clinic.

Case i. The clinical aspects of this case have been reported by Wilder and also by Rankin and Priestley. The pathologic features of the parathyroid tumor removed at operation have been described by Wellbrock. This was the second case in America in which a parathyroid tumor was removed for the relief of hyperparathyroidism. The patient was a woman, aged thirty-five years, who had been incapacitated for six years. The long history of anemia, pains in the legs, weakness, loss of weight, fatigability, tenderness of bone, and bone tumors of giant-cell type in the maxilla and generalized osteoporosis was at first considered to be due to a nutritional deficiency with osteoporosis and unexplained formation of giant-cell tumor; however, when the possibility of hyperparathyroidism was considered, following Barr, Bulger and Dixon's[13] report in 1929, the elevated concentration of calcium in the serum, the depressed concentration of phosphorus in the serum and the palpable tumor in the parathyroid region readily clinched the diagnosis. To complete the clinical picture a left renal calculus was discovered six months after the removal of the parathyroid tumor. Six years later, this calculus had to be removed on account of left renal colic. The patient died in 1940, and necropsy, performed by Dr. J. D. Edgar, of San Diego, California, revealed an epidermoid carcinoma of the upper end of the esophagus. There was no evidence of parathyroid tumor.

Case ii. This case has been reported by Pemberton and Geddie. A girl, aged fourteen years, presented the problem of a chronic wasting disease for investigation. Weakness, pallor, loss of weight, polyuria and spells of vomiting were the prominent features. The low fixed urinary specific gravity and the finding of a concentration of urea of 80 mg. per 100 cc. of blood suggested chronic glomerulonephritis. However, the roentgenologist reported the calvarium to show a fine mottled appearance suggesting an atypical form of metastasis or the changes found in some of the atypical leukemias. He suggested roentgenographic examination of the pelvis, spinal column and long bones. The long bones showed similar changes to those found in the skull with rarefaction, thinning of cortical bone and, in addition, localized regions of destruction in the right tibia and left ulna. The spinal column and pelvis were reported as showing the diffuse thickening of Paget's disease of the bone. These roentgenographic findings led to the investigation of the calcium metabolism. The concentration of calcium was found to be 17.7 mg. per 100 cc. of serum and that of phosphorus was depressed to 2.4 to 3.2 mg. per 100 cc. of serum. The calcium balance was negative. The diagnosis of hyperparathyroidism was made and a parathyroid tumor was successfully removed. Four years after operation roentgenograms revealed recalcification of the bones and six years after operation the patient's general health was reported to be good.

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* Since then at the clinic eleven cases have been discovered and the tumor has been removed. There are in addition four more cases in which for one reason or another the diagnosis has as yet not been confirmed surgically. This sudden apparent increase in incidence unquestionably reflects the keener diagnostic acumen that follows a high threshold of suspicion.

Case III. This case has been reported by Allan. A man, aged thirty-four years, complained chiefly of weakness in the legs and pains in the hips and knees. These conditions were of two years' duration. A neurologic lesion was suspected but after careful neurologic examination the weakness was considered to be of a muscular type and the pain in the hips and knees to be local. The patient complained also of severe thirst, considered typical of diabetes insipidus. A roentgenologic examination of the skull was made in the course of the neurologic examination, and the roentgenologist reported a fine miliary mottling of the skull. The changes were suggestive to him of hyperparathyroidism. He advised roentgenologic examinations of the spinal column, pelvis and long bones. These showed definite osteoporosis with diffuse granular mottling and multiple cystic regions characteristic of hyperparathyroidism. These findings led to the estimation of the values for serum calcium and serum phosphorus. The concentration of calcium was found to be elevated as high as 16.7 mg. per 100 cc. of serum and that of phosphorus depressed as low as 2.6 mg. per 100 cc. of serum. Further review of the patient's history revealed complaints of weakness, fatigability, indigestion, vomiting spells, loss of weight and rounding of the back. No parathyroid tumor was palpable but the diagnosis of hyperparathyroidism was made.

At operation, a parathyroid tumor was found and removed. On the third day after operation, symptoms and signs of tetany developed. These were controlled with calcium therapy. One year after operation, the patient stated that his general health was good. His weight had increased sixty-five pounds (29.5 kg.) and there was no polyuria. He was able to walk but still used crutches because of a feeling of instability. The right quadriceps tendon was found to have been avulsed from the tibia, allowing the patella to ascend into the thigh. The concentrations of calcium and phosphorus were 9 mg. and 2.3 mg. per 100 cc. of serum, respectively.

Case IV. This case has been reported by Wilder, Camp, Robertson and Adams and also by Rankin and Priestley. The patient was an unmarried woman, aged fifty years at the time of operation in 1932. She first came to the clinic in 1930 complaining of generalized weakness, stiffness in the knees and a pain in the back which extended down along the course of the sciatic nerves. She had been bedridden for two years. She was poorly nourished and anemic. Roentgenographic studies gave evidence of definite osteoporosis of practically all bones and the roentgenologist suggested the diagnosis of hyperparathyroidism. Repeated estimations of the concentration of calcium revealed values ranging from 8.6 to 10.1 mg. per 100 cc. of serum and the concentration of phosphorus ranged from 1.6 to 3.6 mg. per 100 cc. of serum. The clinical diagnosis of carcinomatous metastasis to bone was tentatively made and roentgen therapy instituted. The patient returned home and temporary improvement took place.

However, in 1932, she returned with the same complaints and, in addition, was suffering from severe intermittent cramps in the legs. Roentgenographic studies of the pelvis and spinal column gave evidence of considerable osteoporosis, which was considered indicative of hyperparathyroidism. There was a pathologic fracture of the left femur. The concentration of calcium ranged from 10.6 to 11.8 mg. and that of phosphorus from 2.3 to 3 mg. per 100 cc. of serum. The serum alkaline phosphatase value was 61.7 Bodansky units. A negative balance for calcium was demonstrated and although a tumor was not palpable in the neck the diagnosis of hyperparathyroidism was made and the neck was explored. A parathyroid tumor was found and removed. Following operation, the concentration of calcium fell as low as 5.5 mg. per 100 cc. of serum on the second postoperative day. Evidence of tetany developed. This was controlled by the administration of calcium and a parathyroid extract. During the third postoperative week, severe nausea and vomiting developed, associated with meteorism and diarrhea. The patient gradually declined and died on the seventy-seventh postoperative day.

Case v. This case has been reported by Brown. A married woman, aged fifty-two years in 1935, first registered at the clinic in 1931, complaining of backache of seven years' duration. In the five years preceding registration, she had suffered from two attacks of left renal colic and one recent attack of right renal colic. A dull lumbar backache persisted between the attacks. She was found to have bilateral nephrolithiasis and right pelviolithotomy was performed, the stone being removed from the middle calix of the right kidney. Operation on the left kidney was deferred by the patient.

She returned in 1935, again complaining of pain in the left lumbar region. However, she also complained of pain in the region of the left shoulder and some aching in the knees. Shortly after leaving the clinic in 1931, she had had a traumatic fracture of the right arm, from which she had made a good recovery. She also complained of weakness and readily induced fatigue. She had noticed some increased thirst and polyuria. Hyperparathyroidism was suspected. Roentgenograms of the urinary tract revealed multiple regions of calcification or stones in the left kidney and some small indistinct shadows over the right kidney. There was osteoporosis of the spinal column and pelvis. In the roentgenograms of the thorax, a small soft tissue shadow could be discerned just below the right sternoclavicular joint. It was believed that this might be attributable to a parathyroid tumor. The concentration of urea was 36 mg. per 100 cc. of blood. The concentrations of calcium and phosphorus ranged from 14.7 to 15.3 mg. and from 2.0 to 2.6 mg. per 100 cc. of serum, respectively. The value for serum alkaline phosphatase ranged from 10.0 to 10.2 Bodansky units. The parathyroid region was explored and a parathyroid tumor removed. The concentration of calcium fell to 9.1 mg. per 100 cc. of serum on the third postoperative day, and mild symptoms of tetany developed. These were controlled with calcium therapy. Roentgenologic examination of the chest following removal of the parathyroid tumor revealed that the soft tissue shadow formerly visualized below the right sternoclavicular joint was no longer present.

Case vi. A woman, aged fifty-three years, registered at the clinic in June, 1935. She stated that in 1930 she had commenced to have pain between the shoulder blades. In 1932, she became stooped, pains developed in the arms and legs and she began to lose weight and feel weak. These symptoms gradually increased and five months before registration painful feet and swelling of the ankles developed. She denied any symptoms referable to the gastrointestinal or urinary tracts.

Her body weight was seventy-one pounds (32.2 kg.) and her height 4 feet 4 inches (132.1 cm.) and there were gross kyphosis and scoliosis of the thoracic segment of the spinal column. The concentration of hemoglobin was 13.3 Gm. per 100 cc. of blood and there were 4,120,000 erythrocytes per cubic millimeter of blood. The concentrations of calcium and of phosphorus were 11.6 mg. and 2.8 mg. per 100 cc. of serum, respectively. The value for serum alkaline phosphatase was 12.1 Bodansky units. On roentgenologic examination all bones showed changes characteristic of advanced hyperparathyroidism. There were multiple pathologic fractures of the ribs and marked kyphosis with compression of the thoracic vertebrae. The pelvis and the right humerus showed extensive fibrocystic changes and there were areas of calcification in the splenic region. The renal regions were negative for calculi.

Exploration of the parathyroid region was decided on. At operation a parathyroid tumor was found on the posterior aspect of the right lobe of the thyroid gland. This had not been palpable preoperatively. Following removal of the tumor the concentration of calcium dropped to 7.1 mg. per 100 cc. of serum on the third postoperative day and the patient complained of numbness and tinglings in the extremities. Seventeen days following operation the concentrations of calcium and phosphorus were 8.1 and 4.2 mg. per 100 cc. of serum, respectively, and the serum alkaline phosphatase value was 32.6 Bodansky units. Roentgenologic examination of the skeleton six weeks after operation revealed considerable recalcification. On dismissal there was no evidence of tetany and the patient felt well. She was advised to take cod liver oil and calcium lactate. She has not been heard from since.

Case vii. This case has been reported by Snell and discussed by Mayo. A man, aged forty-seven years, registered at the clinic in December, 1935. His home physician had made a tentative diagnosis of hyperparathyroidism. In 1931, the patient had undergone nephrectomy because of right renal colic and a stone-filled right kidney. One year after this operation he noticed weakness and undue fatigability. In the early months of 1935 he consulted a physician regarding weakness and loss of weight. Marked anemia was discovered and treatment instituted without subjective improvement. Before coming to the clinic in 1935 he had failed rapidly with loss of weight, pain in the legs and weakness. He had lost 4½ inches (11.4 cm.) in height. He had also come to notice a mass in the right cervical region. This had grown rapidly and produced a sensation of choking.

When examined at the clinic the patient was weak, pale and in obvious pain. He had a round back deformity and a moderate degree of pes planus. A tumor was present in the lower right cervical region extending beneath the sternum. The shadow of this tumor was partially visible in roentgenograms of the thorax, displacing the trachea to the left. The average urinary output was found to be about 3 liters a day. Renal function, as measured by the urea and sulfate clearance tests, was greatly reduced. The urea clearance was 11 cc. and the sulfate clearance 6.2 cc. per minute. The concentrations of calcium and phosphorus were 14.9 mg. and 2.6 mg. per 100 cc. of serum, respectively, and the serum phosphatase level was 24 Bodansky units. Roentgenographic examination of the thorax revealed severe osteoporosis with multiple spontaneous fractures of ribs in addition to the large substernal mass. Roentgenograms of the long bones, pelvis and skull revealed the characteristic fine miliary osteoporosis of hyperparathyroidism.

The cervical tumor was explored and removed. It proved to be of parathyroid origin. Following operation the concentration of calcium fell rapidly to 7.8 mg. per 100 cc. of serum and the patient complained of a paresthesias in the fingers and toes. Moderate renal insufficiency with elevation of the concentration of urea to 78 mg. per 100 cc. of blood appeared postoperatively but this rapidly improved with the administration of fluid in large quantities. Seven months after operation his only complaint was of painful feet. He had gained weight and felt well. Roentgenograms revealed diminution of the degree of osteoporosis. The concentration of calcium was 9.4 mg. per 100 cc. of serum.

CASE VIII. A Jewish man, aged twenty-one years, registered at the clinic in May, 1940, complaining of having had two attacks of severe pain in both flanks extending to the groins, two months and one month before registration. He stated that he had suffered from enuresis until the age of thirteen years and from then on had suffered from nocturia, rising once or twice every night. Two years prior to his coming to the clinic he had difficulty passing a life insurance examination because of low urinary specific gravity. He tired easily, had a poor appetite and was chronically constipated. There was no history of loss of weight.

The results of physical examination were not remarkable except for a small, soft mass low on the right side of the neck in the vicinity of the right lobe of the thyroid gland.

The concentration of hemoglobin was 12.7 mg. per 100 cc. of blood and erythrocytes numbered 4,270,000 per cubic millimeter of blood. The urine had a specific gravity of 1.011 to 1.012 and pyruria was graded 2 (on a basis of 1 to 4) with twenty-five cells per high-power microscopic field. The concentration of urea was 32 mg. per 100 cc. of blood. The urea clearance was 18.4 cc. per minute with a volume of 100 cc. The concentrations of calcium and of phosphorus averaged 17.1 mg. and 2.0 mg. per 100 cc. of serum, respectively, and plasma phosphatase averaged 6.8 Bodansky units. The Sulkowitch test showed excretion of calcium grade 3 in the urine.

Roentgenographic examination of the thorax and skull did not reveal any significant pathologic findings but roentgenologic examinations of the urinary tract revealed marked mottled areas of calcification over both renal regions. Excretory urograms were interpreted as indicating slight reduction of function in both kidneys and the renal calcification was shown to be in the calices and also scattered throughout the parenchyma of both kidneys.

The parathyroid region was explored and a tumor of the right inferior parathyroid gland was removed. The serum calcium dropped rapidly following operation. On the fourth postoperative day the patient experienced tinglings in the extremities and Chvostek's sign was positive. The concentrations of calcium and phosphorus were 9.6 and 1.5 mg. per 100 cc. of serum, respectively, and the value for serum alkaline phosphatase was 4.6 Bodansky units. Seven weeks after operation the Sulkowitch reaction was graded as 0.

One year after operation the patient was examined at the clinic. He felt well. The values for calcium, phosphorus and phosphatase were 10.1 and 3.1 mg. per 100 cc. of serum and 1.6 Bodansky units, respectively. The urine showed a specific gravity of 1.018, pyuria was graded 2 (twenty-two cells per high-power field) and there was less calcification of the left renal region as compared with the roentgenograms taken before operation. However, there was then present some recognizable osteoporosis in the roentgenograms of the ribs, spinal column and pelvis.

CASE IX. A married woman, aged twenty-nine years, registered at the clinic in July, 1940. She had given birth to three children, one of whom was born dead. Following the birth of her last child, twenty-one months previously, she had begun to lose weight and suffer from malaise. For six months she had noticed progressive weakness, fatigability and loss of appetite and for three weeks prior to registration she had suffered from morning vomiting. She had lost twenty-six pounds (11.8 kg.). She was hospitalized and investigated.

The urinary specific gravity was 1.010. The concentration of hemoglobin was 12.5 Gm. per 100 cc. of blood and the erythrocytes numbered 4,350,000 per cubic millimeter of blood. The blood sedimentation rate averaged 62 mm. per hour on two recordings. There was no fever but there was persistent tachycardia. Roentgenologic studies of the chest and stomach gave negative results. The patient was quite content on a low caloric diet and when the caloric intake was increased to 2,000 calories she complained of a feeling of overdistention. Anorexia nervosa was suspected. A differential leukocyte count, examination of blood smears, repeated blood cultures and a tuberculin test all gave negative or normal results. Nine days after admission the patient complained of abdominal pain but on examination the abdomen was soft and no masses were palpable. She became restless, the pulse rate rose further and on the evening of the ninth hospital day she suddenly became cyanosed and died.

Necropsy revealed a tumor of the right inferior parathyroid gland, measuring 4 by 2 by 2 cm. and weighing 4.2 Gm. There was an extreme degree of decalcification of the skull, vertebrae and ribs. The calvarium was so soft that it could be indented by finger pressure. The kidneys showed deposition of calcium in the walls of the collecting tubules and hyalinization of numerous glomeruli. On gross examination the calcium appeared to be deposited at the corticomedullary junction. Calcium was also found in the walls of the alveoli and bronchi. The bones showed proliferation of young connective tissue in the narrow spaces with many osteoclasts next to the lacunae. The terminal event was severe hemorrhagic edema of the lungs with beginning pneumonia.

CASE X. An unmarried woman, aged thirty-six years, came to the clinic in August, 1940, complaining of pains in the knees of three years' duration. Just prior to admission, the ankles had also become painful. She had felt weak and had been easily exhausted for three years. For two years she had experienced an unexplained fever with temperature up to 102°F.

Physical examination revealed moderate dorsal kyphosis and a pressure tenderness over both patellae. The urinary specific gravity ranged from 1.007 to 1.010. The concentration of hemoglobin was 13.3 Gm. per 100 cc. of blood and erythrocytes numbered 4,670,000 per cubic millimeter of blood. The concentration of urea was 18 mg. per 100 cc. of blood. The concentrations of calcium and phosphorus were 14.8 and 1.6 mg. per 100 cc. of serum, respectively, and for phosphatase 4.9 Bodansky units. The urinary excretion of calcium as indicated by the Sulkowitch test was graded 2 on a basis of 1 to 4.

Roentgenograms revealed generalized osteoporosis with areas of rarefaction in the patellae. There was no evidence of renal calcification.

The parathyroid regions were explored and a tumor of the upper left parathyroid gland was removed. On the third day after operation the patient experienced numbness and tinglings of the fingers and toes. The concentration of calcium was then 9.1 mg. per 100 cc. of serum. Recovery was very satisfactory. She was dismissed three weeks after operation. Occasional paresthesias which she was having at that time could be controlled with the administration of calcium lactate by mouth.

CASE XI. This case is reported through the courtesy of Dr. Frank Heck. An unmarried woman, aged twenty-one years, registered at the clinic in June, 1941. She had been in good health until 1936 when she began to notice stiffness of the interphalangeal joints with aching on movement. In 1938, a tooth had been extracted. Following this she had been in bed for three months with weakness, nausea and vomiting and pain in the right side of the face and head. She lost seventy pounds (31.8 kg.). Examinations of blood had revealed some anemia and leukocytosis. She did not recover completely from this upset. Walking became difficult and weakness and dyspnea developed on exertion. For several months before admission to the clinic she suffered from a dull ache in the left costovertebral angle with some extension to the left groin.

Physical examination revealed pallor and some enlargement of the proximal interphalangeal joints with limitation of movement. There was a moderate degree of pes planus. A small nodule could be felt near the left lower thyroid pole. Urinalysis revealed a specific gravity ranging from 1.009 to 1.014 with albuminuria graded 2 and pyuria graded 1 (eight cells to the high-powered field). Four estimations of the concentration of urea revealed values ranging from 58 to 82 mg. per 100 cc. of blood. The concentrations of calcium and of phosphorus were 16.0 mg. and 2.9 mg. per 100 cc. of blood, respectively, and that for phosphatase was 19.1 Bodansky units. The Sulkowitch test of urinary excretion of calcium revealed a slight trace of calcium in the urine.

The concentration of hemoglobin was 10.5 Gm. per 100 cc. of blood. Erythrocytes numbered 4,770,000 and leukocytes 7,900 per cubic millimeter of blood.

Roentgenograms revealed diffuse granular osteoporosis with cystic changes in the iliac bones. There were irregular regions of calcification, many of which were partially ossified, in the soft tissues anterior to the proximal interphalangeal joints of the fingers. Roentgenograms of the renal regions revealed multiple areas of calcification in each kidney. Roentgenograms of the sinuses revealed a large cyst in the floor of the right antrum, with transformation of the bone pattern throughout the entire maxilla and mandible.

The parathyroid regions were explored and a tumor of the left inferior parathyroid was found and removed. In spite of a liberal fluid intake the concentration of urea rose to 154 mg. per 100 cc. of blood on the fifth postoperative day. After this the value for the blood urea gradually subsided and within three weeks it had reached normal levels. On the third postoperative day Trousseau's sign became positive and tingling developed in the hands and feet. This was controlled by the oral administration of calcium lactate. On the fourth postoperative day the concentrations of calcium and phosphorus were 7.4 and 2.8 mg. per 100 cc. of serum, respectively, and the value for serum alkaline phosphatase was 25.1 Bodansky units. The patient continued to have mild tingling sensations until the time of dismissal five weeks after operation. At this time she felt very well, was putting on weight and was taking 4 Gm. of calcium lactate daily. The concentrations of calcium and phosphorus were 7.8 and 2.9 mg. per 100 cc. of serum, respectively, and the value for serum alkaline phosphatase was 9.4 Bodansky units.

Case xii. An unmarried woman, aged twenty-five years, first presented herself at the clinic in January, 1940. She complained that for six months she had been subject to intermittent muscular aches and had become weak, nervous and irritable. Following physical and laboratory examinations diagnoses of nervous exhaustion and dental sepsis were made.

She returned two years later because of two attacks of left renal colic. She also complained of soreness of the right costal margin referred to the back and right shoulder. This was associated with gaseous abdominal distention on account of which she had excluded milk, cream, butter and cheese from her diet.

Physical examination revealed a pale, undernourished young woman sixty-five inches in height (165.1 cm.) and weighing ninety-two pounds (41.7 kg.). Roentgenologic examination of the urinary tract revealed multiple calculi in both kidneys. Roentgenologic cholecystography revealed a functioning gallbladder with stones. The concentrations of calcium and phosphorus were 10.7 and 1.8 mg. per 100 cc. of serum, respectively. The value for serum alkaline phosphatase was 4.1 Bodansky units.

In February, 1942, right pelviolithotomy was performed, followed in June, 1942, by left pelviolithotomy. At this time the possibility of hyperparathyroidism was again considered. Repeated estimations of the concentration of calcium revealed values ranging between 12.2 and 13.9 mg. per 100 cc. of serum with an average of 13.3 mg. The concentration of phosphorus ranged between 1.9 and 2.3 mg. per 100 cc. of serum with an average of 2.1 mg. The value for serum alkaline phosphatase was 3.5 Bodansky units. The concentration of protein was 7.0 Gm. per 100 cc. of serum and for hemoglobin 12.5 Gm. per 100 cc. of blood. Roentgenograms of the head and long bones revealed slight generalized osteoporosis. Roentgenoscopic examination of the thorax did not reveal any evidence of mediastinal tumor. The specific gravity of the urine ranged from 1.008 to 1.020 and the concentration of urea was 20 mg. per 100 cc. of blood. The Sulkowitch test showed calcium excretion graded 4.

A diagnosis of hyperparathyroidism was made and on June 30, 1942, the parathyroid regions were explored and a parathyroid tumor was removed.

On the third postoperative day cramping and tinglings in the extremities and a positive Chvostek sign developed. The concentrations of calcium and phosphorus were 10.0 and 1.9 mg. per 100 cc. of serum, respectively. The clinical evidences of tetany were controlled by oral administration of calcium lactate. Seventeen days after operation the concentration of calcium had fallen to 8.5 mg. and that of phosphorus had risen to 3.4 mg. per 100 cc. of serum. The value for serum alkaline phosphatase was 4.1 Bodansky units and the patient was free from symptoms.

In September, 1942, cholecystectomy and appendectomy were performed and a ganglion was excised from the ventral surface of the right wrist. Analysis of a gallstone removed with the gallbladder revealed 0.55 mg. of calcium per 100 mg., present as calcium carbonate.

The patient was dismissed from the clinic on October 14, 1942, at which time she was gaining weight and stated that she felt in excellent condition.

CASE XIII. A man, aged thirty-one years, presented himself at the clinic on July 8, 1942, complaining of weakness of the legs and pains in the hips and knees. During the eight years preceding his visit to the clinic he had lost thirty-six pounds (16.3 kg.) and he had noticed a decrease in height of two and three-fourths inches (7.0 cm.). He had been treated for anemia by his local physician. Three years before registration at the clinic he had undergone partial gastrectomy for duodenal ulcer. Three months before registration tonsillectomy had been performed without improvement in his general condition.

Physical examination revealed a white man sixty-eight and one-fourth inches (173.4 cm.) in height and weighing 120 pounds (54.4 kg.). There was evidence of considerable generalized muscular weakness. On walking, the patient tended to swing the pelvis from side to side. There was no tumor palpable in the neck.

The urinary specific gravity ranged from 1.026 to 1.028. Albumin was present in one specimen of urine. Excretion of calcium in the urine was graded 2 as measured by the Sulkowitch test. The concentration of urea was 40 mg. per 100 cc. of blood.

The concentration of hemoglobin was 12.7 Gm. per 100 cc. of blood and examination of a blood smear did not reveal any diagnostic features. The concentration of protein was 6.5 Gm. per 100 cc. of serum. A flocculation test for syphilis was reported as giving negative results.

Roentgenograms revealed diffuse osteoporosis of the entire skeleton with fibrocystic changes in the ribs, ilia and right tibia. A roentgenogram of the thorax revealed slight bilateral diffuse pulmonary fibrosis and bilateral emphysema. Roentgenoscopic examination of the thorax for possible mediastinal tumor gave negative findings.

On the basis of the roentgenologic findings, estimations of the serum calcium, phosphorus and phosphatase were made. The average concentration of calcium was 13.0 mg. and for phosphorus 2.0 mg. per 100 cc. of serum. The serum alkaline phosphatase measured 17.8 Bodansky units.

A diagnosis of hyperparathyroidism was made and the parathyroid region explored on July 21, 1942. A parathyroid tumor was found and removed. On the third postoperative day tinglings and crampings in the extremities and a positive Chvostek sign developed. Estimation of the concentration of calcium and phosphorus at this time revealed values of 7.6 and 2.5 mg. per 100 cc. of serum, respectively. The tetany was relieved by oral administration of calcium lactate and vitamin D.

The patient was dismissed from the clinic on August 1, 1942, in good general condition, although Chvostek's sign was still positive. He was advised to follow a high calcium diet. At the time of his dismissal the Sulkowitch reaction for urinary excretion of calcium was graded 0, the concentrations of calcium and phosphorus were 8.5 and 2.1 mg. of serum, respectively, and the serum alkaline phosphatase recorded 42.7 Bodansky units.

Case xiv. A woman, aged fifty-five years, first registered at the clinic on July 23, 1942. She complained that for four years she had suffered from severe generalized weakness with soreness in the bones and muscles of the legs. Ligation of varicose veins and treatment for arthritis did not relieve her distress. Sixteen months before registration at the clinic she had a bony tumor removed from the left tibia at which time she was told that she had little calcium in her bones. Eight months previous to registration she underwent an operation on her neck in the course of which a parathyroid tumor was said to have been removed; however, she did not improve and became bedridden because of weakness. Two months prior to registration she had an attack of colicky pain in the right flank associated with nausea and vomiting. Four days before presenting herself she passed a stone during micturition.

Physical examination revealed a pale, edentulous woman unable to arise from bed. There was considerable dorsal kyphosis. There was a transverse scar in the neck and a small nodule was palpable in the region of the lower pole of the thyroid gland on the right side. There was a linear scar over the left tibia, the subcutaneous surface of which was irregular.

The concentration of hemoglobin was 10.8 Gm. per 100 cc. of blood. The erythrocytes numbered 3,780,000 and the leukocytes 4,200 per cubic millimeter of blood. The concentration of urea was 16 mg. per 100 cc. of blood. In repeated estimations the concentrations of calcium ranged between 12.7 and 13.7 mg., those for phosphorus between 1.9 and 2.2 mg. per 100 cc. of serum and those for phosphatase between 8.4 and 15.8 Bodansky units. The concentration of protein was 5.8 mg. per 100 cc. of serum. A flocculation test for syphilis was recorded as giving negative results. The urinary specific gravity ranged between 1.002 and 1.011. The Sulkowitch test revealed grade 2 excretion of calcium. Analysis of a stone passed in the urine revealed it to be composed of calcium phosphate.

Roentgenologic examination revealed regions of fibrocystic disease involving the bones of the leg and thigh, left scapula and both ilia. The calvarium appeared decalcified. There was a sclerosing process involving the innominate bones, entire spinal column, ribs and both clavicles. Multiple opaque shadows were present in the region of the gallbladder. Urographic studies revealed a stone in the lower calix of the left kidney. Roentgenologic examination of the thorax revealed slight cardiac enlargement with torsion of the aortic arch. There was no evidence of an intrathoracic tumor.

A diagnosis of hyperparathyroidism was made and on July 29, 1942, the parathyroid regions in the neck were explored but no parathyroid tumor was found. The thyroid gland was found to be enlarged and it contained multiple adenomas. Subtotal thyroidectomy was performed. On October 16, 1942, the anterior mediastinum was explored through a sternal splitting approach and a parathyroid tumor was removed from the left side of the anterior mediastinum.

The postoperative course was uneventful. By the fourth postoperative day the concentration of calcium had fallen to 8.5 mg. per 100 cc. of serum and on the fifth day the concentrations of calcium and phosphorus were 7.0 and 1.9 mg. per 100 cc. of serum, respectively. The serum alkaline phosphatase was 15.9 Bodansky units. No evidence of tetany appeared. Throughout the postoperative period the patient was given calcium lactate and vitamin D by mouth. She was dismissed from the clinic on November 2, 1942, at which time she stated that she felt better than she had felt for years.

REVIEW OF THE CLINICAL FEATURES OF FOURTEEN CASES OF HYPERPARATHYROIDISM DUE TO PARATHYROID TUMOR

Age. The average age at the time of operation was thirty-six years. The youngest patient was a girl aged fourteen years and the oldest a woman aged fifty-five years.

Sex. There were ten women (71.4 per cent) and four men (28.6 per cent). In their review of cases of proved hyperparathyroidism Wilder and Howell found thirty-one men and ninety-nine women and five cases in which the sex was not reported.

Duration. The average duration of symptoms was 3.9 years. The longest duration of symptoms occurred in Case v. Backache had commenced eleven years and renal colics nine years before operative removal of the parathyroid tumor. When the patient was first seen at the clinic, seven years after the onset of backache, there were no appreciable roentgenologic changes in the spinal column and pelvis. A rotentgenogram of the skull was not made at that time. Albright, Aub and Bauer[3] reported a case in which there was reason to believe that the symptoms of hyperparathyroidism had existed for thirty-nine years.

The shortest duration was found in Case II, in which a girl, aged fourteen years, presented symptoms of sixteen months' duration.

Type of Disease. Many writers have attempted to classify cases of hyperparathyroidism into clinical groups. Cases were reported depending on whether changes in the urinary tract or changes in the skeletal system dominated the clinical picture. Acute parathyroid poisoning has also been described.

Following the classification of Albright, Aub and Bauer, eight patients (57.1 per cent) (Cases I, III, IV, VI, X, XI, XIII and XIV) might be said to have suffered from classic hyperparathyroidism with decalcification, cysts, tumors and fractures predominant in the clinical picture; however, in five of these cases symptoms or signs referable to the urinary tract were also present. Six months after operation one patient (Case I) was found to have a left renal calculus which subsequently required removal. One patient (Case III) suffered from marked polyuria and polydipsia before operation. One patient (Case X) had a persistently low urinary specific gravity before operation and another patient (Case XI) showed multiple regions of calcification in each kidney with a decreased urinary specific gravity and an elevation of the concentration of urea in the blood. Case XIV presented both cholelithiasis and nephrolithiasis.

Four patients (28.6 per cent) (Cases V, VII, VIII and XII) presented nephrolithiasis as the most prominent early feature. One patient (Case V) underwent right pelviolithotomy four years before the diagnosis of hyperparathyroidism was made. Another (Case VII) underwent right nephrectomy for a stone-filled kidney. Following this operation, symptoms resulting from hypercalcemia and skeletal disease appeared and four years later the correct complete diagnosis was made. A third patient in this group (Case VIII) presented himself with bilateral renal calculi and nephrocalcinosis but with negligible skeletal involvement. However, one year after removal of the tumor there was recognizable osteoporosis of the ribs, spinal column and pelvis. The fourth patient in this group (Case XII) was operated upon for bilateral nephrolithiasis before hyperparathyroidism was recognized. Diagnosis was delayed because the concentration of calcium before the first pelviolithotomy was 10.7 mg. per 100 cc. of serum, although that of phosphorus was depressed to 1.8 mg. per 100 cc. of serum. Subsequently, evidence of hypercalcemia and decalcification developed. This patient also suffered from cholelithiasis.

One patient (Case II) presented a clinical picture of the type described as hyperparathyroidism with renal insufficiency. However, the skeletal system was roentgenographically shown to have undergone marked decalcification, formation of cysts and pathologic fractures.

One patient (Case IX) suffered from the type of disease described as acute parathyroid poisoning.

No patient was found to fall into the group of the uncomplicated osteoporotic form of hyperparathyroidism or hyperparathyroidism simulating Paget's disease, as described by Albright, Aub and Bauer. In Case XIV, however, there was roentgenographic evidence of the sclerosing process involving the innominate bones, spinal column, ribs and clavicles.

Miscellaneous Clinical Data. The two most consistent symptoms were weakness and fatigability. These were found in every case. Other symptoms and signs, probably dependent upon hypercalcemia, were, in order of frequency of occurrence, loss of weight, impaired appetite, constipation, indigestion, nausea and vomiting. Pes planus, possibly due to muscular hypotonia, was present in two cases.

Changes in the skeleton caused the patients to have symptoms of a more painful nature. Nine patients in this group had among their chief symptoms pain in the lower extremities or in the back and lower extremities. Loss of height and the development of kyphosis were noted in seven cases. Pathologic fracture occurred in six cases. A bone tumor in the maxilla was present on gross examination in one case. This tumor disappeared spontaneously after removal of the parathyroid tumor. Roentgenographic examination revealed a large cyst in the floor of the maxillary sinus in one case. Stiffness of the fingers with limitation of movement, superficially resembling infectious arthritis of the fingers, was noticed in one case.

Roentgenologic studies of the skeletal system were not done on one patient (Case IX), but necropsy revealed gross osteitis fibrosa generalisata. Preoperative roentgenologic studies revealed osteoporosis with regions of formation of cysts, localized rarefaction or pathologic fracture in eleven cases. Two patients showed merely generalized osteoporosis and one patient did not show any recognizable bony changes preoperatively, although osteoporosis was recognized postoperatively. Thus, all patients showed some bony abnormality.

Symptoms and signs dependent upon excretory factors were only slightly less prominent than those of the skeletal system. In four instances (28.6 per cent) the patients first sought medical attention because of renal calculi and, in all, renal calculi or calcification in the kidney was recognized in eight cases (57.1 per cent). Polyuria and polydipsia were noticed by the patient in five instances. In one instance (Case III) these were severe, the fluid intake being as much as 12 liters in twenty-four hours. However, in nine cases the specific gravity of the urine was found to be consistently low and relatively fixed. In two of these cases the concentration of urea was elevated to as high as 80 mg. per 100 cc. of blood before operation. Impaired renal function in two more of these cases was evidenced in the excretory urographic findings and in the results of urea and sulfate clearance tests.

Studies of calcium balance were carried out in the first four cases. A negative balance for calcium was found in three cases. In one instance, however, (Case I) the calcium balance was positive but this test followed treatment with ultraviolet light and vitamin D. The Sulkowitch test was applied preoperatively to the urine in six cases and the precipitate was graded as 4, on a basis of 1 to 4, in one case, 3 in one case, 2 in three cases and in another the test was interpreted as showing a trace of urinary calcium.

Roentgenologic examination of the thorax revealed in two instances (14.3 per cent) the partial outline of a tumor which was subsequently shown to be the parathyroid tumor. Spontaneous fractures of ribs were found in two cases and in one case metastatic calcification in the pulmonary parenchyma was recognized.

The parathyroid tumor was itself palpable in three cases (21.4 per cent) while in two additional cases it pushed up the corresponding lobe of the thyroid sufficiently to give rise to a palpable mass. These five cases include the two cases in which the parathyroid tumor was visualized in the roentgenogram of the chest.

Examination of the blood revealed a concentration of hemoglobin of less than 12 Gm. per 100 cc. of blood in five cases. However, most patients had received some form of anti-anemic treatment during the course of their chronic illness.

The concentrations of calcium and phosphorus in the serum were estimated in thirteen cases. In four cases (30.8 per cent) the concentration of calcium was less than 12.5 mg. per 100 cc. of serum on at least one estimation. The lowest value recorded was 10.6 mg. per 100 cc. In all thirteen cases at least one estimation of the concentration of phosphorus was less than 3 mg. per 100 cc. of serum. The highest estimation exceeded 3 mg. in only one instance. The value for serum alkaline phosphatase was estimated in ten cases and values from 3.5 to 61.7 Bodansky units were found before operation.

Following operative removal of the parathyroid tumor the concentration of calcium in the serum fell to normal or subnormal levels within twenty-four hours and within the first four days after the operation some manifestations of tetany, subjective or objective, were recorded in all but one instance (Case XIV). The duration of these manifestations varied from a few days to several weeks.

The concentration of phosphorus in the serum rose slowly to normal limits. Often, however, this rise followed a temporary further decrease during the immediate postoperative period. The value for serum phosphatase sometimes became more elevated after operation and in one case had not returned to normal levels seven months after operation. Return to normal limits was more rapid in those cases in which there was less skeletal damage.

A marked decrease of the urinary output of phosphorus and calcium was observed to follow operation in those cases in which balance studies were carried out.

In Case IV death followed operation on the seventy-seventh postoperative day. In the remainder of the cases in which operation was performed, considerable subjective and objective improvement followed operation. Gain of weight and strength was great and some patients stated that they felt better than they had felt for years. Pain and tenderness of the bones decreased or disappeared and the bones recalcified slowly. In Case I a bone tumor of the maxilla disappeared spontaneously. Renal function improved and in Case VIII roentgenologic examination of the regions of the kidneys one year after removal of the parathyroid tumor revealed some decrease of the degree of nephrocalcinosis.

In one instance (Case IX) operation was not performed because the correct diagnosis was not made before death. Anorexia nervosa was suspected and treatment directed toward this was instituted, pending further investigation. However, abdominal pain, restlessness and tachycardia suddenly developed and in a few hours the patient became cyanosed and died.

COMMENT

When first confronting the physician, these patients appeared to present widely different diagnostic possibilities. First impressions of the physician included renal calculi, sciatic neuritis, chronic glomerulonephritis, nutritional deficiency with anemia and osteoporosis, menopausal osteoporosis, anorexia nervosa, chronic infectious arthritis, osteomyelitis and bone tumor. Further investigation, however, usually either discredited the tentative diagnosis or revealed the underlying etiologic factor. In one instance, however, the clinical picture so closely resembled anorexia nervosa that the patient died in acute hyperparathyroidism before the diagnosis was established.

The course of events immediately preceding death in this case was similar to the terminal phenomena in the cases of acute hyperparathyroidism reported by Dawson and Struthers, Hanes, Oliver, and Smith and Cooke. Albright[2] has advised that patients who have severe hyperparathyroidism be placed on a diet low in calcium until the offending tumor can be removed. He stated the danger signals of parathyroid poisoning to be rising concentrations of phosphorus and nonprotein nitrogen in the serum associated with urinary suppression.

In four instances the concentration of calcium was less than 12.5 mg. per 100 cc. of serum on at least one estimation. In Case I, however, repeated examinations revealed higher values. In Case IV, the diagnosis was deferred for two years because of the apparent absence of hypercalcemia. In Case VI, the diagnosis was made at the first examination at the clinic in spite of a concentration of calcium of

11.2 mg. per 100 cc. of serum. In Case XII the initial estimation of the concentration of calcium was 10.7 mg. per 100 cc. of serum. Bilateral removal of renal calculi was carried out before the hyperparathyroidism was recognized.

Shelling has placed the normal concentration of calcium in the serum at 9.5 to 11.5 mg. per 100 cc. with an average value of 10.5 mg. per 100 cc. In hyperparathyroidism, he found the values to range from 12.5 to 29.4 mg. per 100 cc. However, in 1937, Albright, Sulkowitch and Bloomberg,[4] reporting on thirty-five cases of hyperparathyroidism from the Massachusetts General Hospital, found eleven cases in which the concentration of calcium was less than 12.5 mg. per 100 cc. of serum.

The Sulkowitch test showed calcium excretion preoperatively graded more than 2 in two (33.3 per cent) of the six cases in which the test was applied. The test provides a rough index of the presence or absence of excessive urinary calcium at the time of its application and can be regarded only as a rough bedside test, by no means diagnostic of hyperparathyroidism. In conditions of acidosis the urinary excretion of calcium is increased and the Sulkowitch reaction may be strongly positive. In both instances in which the Sulkowitch reaction was strongly positive in this series the most prominent clinical manifestation was renal lithiasis. In one instance the concentration of calcium before operation averaged 13.3 mg. and in the other instance 17.1 mg. per 100 cc. of serum. On the other hand, in four cases (66.7 per cent) of proved hyperparathyroidism, in two of which renal calculi were present, the Sulkowitch test did not reveal an excess of urinary calcium. The test is thus only of supplementary value and must be considered along with the whole clinical picture. The dietary supply of calcium and any tendency toward acidosis must also be considered in reaching the correct interpretation of the Sulkowitch test.

In only one instance was the concentration of phosphorus higher than 3.0 mg. per 100 cc. of serum. In this case (Case II) there were impairment of renal function as evidenced by polyuria, a urine of low fixed specific gravity, elevation of the concentration of urea in the blood and impaired excretion of phenolsulfonphthalein. Albright, Aub and Bauer have shown that the value for serum phosphorus may not be low in cases in which hyperparathyroidism has progressed to marked renal insufficiency.

Albright, Aub and Bauer expressed the belief that the serum phosphatase level is an index of osteoblastic activity and found it to be elevated in hyperparathyroidism in proportion to the amount of disease of bone present. This finding is borne out in the series of cases under study. In Cases VIII, X and XII, with average preoperative values for serum phosphatase of 6.8, 4.9 and 3.8 Bodansky units, respectively, there was either no recognizable bony disease (Case VIII) or slight bony rarefaction (Cases X and XII). In the other cases the changes in the bone were greater and the serum alkaline phosphatase values were more than 10 Bodansky units.

In 1937, Albright, Sulkowitch and Bloomberg[4] found that in twelve of thirty-five cases there was no demonstrable disease of bone. These cases had been recognized by the routine investigation of cases of nephrolithiasis for other possible evidence of hyperparathyroidism.

In the series under present discussion, three patients (21.4 per cent) had operative procedures for renal calculi without bone changes being recognized. On one patient (Case V) right pelviolithotomy was performed at the clinic. Four years later, bony changes had developed and the complete diagnosis was made. From another patient (Case VII) the right kidney had been removed elsewhere before the diagnosis of hyperparathyroidism was made at the clinic. At the time of the first operation the patient had not made any complaints other than of right renal colics but severe changes of bone were present when he was seen at the clinic four years later. From another patient (Case XII) calculi were removed at the clinic from both kidneys before roentgenologic evidence of slight bony decalcification was recognized. In Case VIII bilateral renal calculi were present and roentgenograms taken before removal of the parathyroid tumor did not reveal any bony changes. However, following operation, osteoporosis was recognized. In this case the duration of symptoms was two years, while the average duration of symptoms for the whole group was 3.9 years. These observations lend support to the contention that changes of bone are an index of the duration of the disease rather than of its severity. They also emphasize the importance of keeping hyperparathyroidism in mind when dealing with cases of renal lithiasis.

Eight patients (57.1 per cent) showed evidence of renal lithiasis or nephrocalcinosis. In 1934, Albright, Baird, Cope and Bloomberg[5] reported the incidence of renal calculus in hyperparathyroidism to be 27 per cent. However, in 1937, Albright[1] stated that hyperparathyroidism carried an incidence of renal calculus of about 70 per cent. There has been much debate regarding the incidence of hyperparathyroidism in cases of renal calculus. Barney and Mintz,[10] in 1934, stated that parathyroid disease is the apparent etiologic factor in at least 10 per cent of the cases in which stones form in the urinary tract. Later, in 1936,[11] from 4 to 5 per cent was given by the same authors as a more correct figure. In 1937, Albright[1] considered that about 5 per cent of renal calculi consisting of calcium phosphate were due to hyperparathyroidism. In 1938, Griffin, Osterberg and Braasch found hyperparathyroidism to be an etiologic factor in less than 0.2 per cent of 1,206 cases of urinary lithiasis which they studied at the Mayo Clinic; however, in only 229 of these cases were laboratory studies of the serum calcium, phosphorus and alkaline phosphatase performed.

Study of the fourteen cases under review supports the statement of Albright that in all cases of renal stones consisting of calcium phosphate hyperparathyroidism should be suspected until this is ruled out by chemical studies, regardless of whether or not disease of bone is present.

SECTION II. PATHOLOGIC CONSIDERATIONS

THE GENERAL FEATURES OF PARATHYROID TUMORS

The first descriptions of parathyroid tumors were probably given by DeSanti in 1900 and Benjamins in 1902.

DeSanti found a large vascular tumor in the thyroid region of a man aged fifty-eight years. This was removed at operation undertaken because of hoarseness, dyspnea and cough. Microscopic examination showed that the tumor consisted of parathyroid tissue.

Benjamins' case was that of a man fifty-seven years of age who had a tumor in the neck the size of a child's head. This was removed surgically. It was round and circumscribed and did not show any invasive tendencies. It was removed because of the mechanical disturbance that it caused. From its situation and structure Benjamins considered it to be a parathyroid tumor.

In 1915, Harbitz reviewed the literature on the parathyroid tumors described up to that time. He found that most of them had been accidentally discovered at necropsy. The majority were small, single tumors averaging from 2 to 2.5 cm. in diameter and were soft and grayish red. In a few cases the tumors were larger and had been removed at operation because of pressure on the surrounding structures. In these cases, which included DeSanti's and Benjamins', the tumors were so meagerly described as regards structure that Harbitz was not entirely convinced of their parathyroid origin.

In 1925, Hoffheinz commented on all the cases of parathyroid enlargement which he could find reported from 1900 to 1925. He found forty-five cases in which parathyroid tumor or hyperplasia was certain. In 1930, Barr and Bulger were able to add another twenty-nine cases, bringing the total to seventy-four cases. However, only about seventeen of these were considered by Barr and Bulger[12] to be cases of parathyroid tumor.

Since Mandl's[50] contribution to the surgical treatment of parathyroid tumors many more cases have been reported and more careful histologic studies have been performed. In 1931, Hunter and Turnbull gave a careful description of the clinical and pathologic features of cases of generalized osteitis fibrosa due to parathyroid hyperfunction. They found that any of the cellular elements normally present in the parathyroid might be involved, separately or in combination, in the hyperplastic or neoplastic process, causing hyperparathyroidism with generalized osteitis fibrosa. Erdheim[27] found the oxyphil cells to predominate in the enlarged parathyroids associated with skeletal disease, while Hoffheinz and Wellbrock found the clear, chief cells to be more in abundance.

In 1935, Castleman and Mallory reported the detailed histologic appearance of the parathyroid glands in twenty-five cases of hyperparathyroïdism. They found it possible to divide the cases sharply into two groups. The first group was characterized by diffuse uniform changes throughout all the glandular tissue, an obviously hyperplastic process. The second group was characterized by a proliferative region limited to one gland, frequently even to a portion of it, or, rarely, involving parts of two glands. They regarded this localized type of growth as neoplastic.

They proposed further subdivision of each group based on the morphologic criteria of the predominant cell type and the cellular arrangement. They were able to apply this classification to a group of 160 cases of hyperparathyroidism, of which they collected reports from the literature.

They found the incidence of hyperplasia to be 13.6 per cent and of neoplasia to be 86.4 per cent. The hyperplasia most commonly was of the generalized wasserhelle cell type. The neoplasia was single in 128 of 140 cases and multiple in twelve. The chief cell with its transition forms was by far the most common cell type in the neoplastic group, although wasserhelle cell types were also seen.

Castleman and Mallory were able to show a rough quantitative relation between the size of the enlarged glands and the degree of hyperfunction as judged by the degree of elevation of the concentration of calcium in the serum.

In 1940, Fahrni reported that in his series of seven patients who had hyperparathyroidism, two patients each had two tumors. Of the nine parathyroid adenomas, three were in the mediastinum, one was intrathyroid and five were in the normal position of one of the parathyroid bodies.

In 1941, Cope reported on sixty cases of hyperparathyroidism observed at the Massachusetts General Hospital. The diagnosis was proved at operation in fifty-eight cases and at necropsy in two cases. In fifty-four cases the disease was due to formation of adenoma and in six, to primary hyperplasia. In four of the fifty-four cases due to adenoma there were two adenomas, in the rest only one. Of this total of fifty-eight adenomas, eleven were found in the anterior mediastinum and five in the posterior mediastinum.

MALIGNANT PARATHYROID TUMORS

In 1899, Kocher reported five malignant glycogen-containing tumors which he had observed in the region of the thyroid gland. He expressed the belief that these were of parathyroid origin. In 1907, Langhans described four similar cases in which he interpreted the lesions as malignant parathyroid tumors. In 1915, Harbitz was inclined to interpret these as cases of primary malignant tumors of the thyroid gland rather than of the parathyroid glands. In 1909, de Quervain described an invasive, infiltrating tumor of the neck which he believed had the histologic appearance of a parathyroid tumor. Following operation, the tumor recurred locally and metastasized to the lungs.

In 1914, Roffo and Landivar reported the case of a patient who had noticed a lump in the neck for thirty-five years. This had grown considerably and was associated with a mediastinal tumor simulating an aortic aneurysm. These tumors were removed but the patient died four months after operation. Necropsy revealed local recurrence, invasion of the thyroid gland and metastatic growths in the lungs and liver. Histologically, the tissue of the tumors was found to be composed of follicles with columns of cylindrical cells containing nuclei in mitosis. Roffo and Landivar expressed the belief that these tumors were of parathyroid origin.

In 1923, Fasiani reported a tumor of the neck which had invaded the thyroid gland. The tumor cells showed much mitosis and were believed to have arisen from a parathyroid gland. He expressed the belief that the tumor was a malignant parathyroid adenoma.

In 1925, Ferrero and Sacerdote reported the case of a woman in whose femur a tumor developed. She had noticed a small tumor in the neck for fourteen years. In the course of the examination the femur fractured but union occurred within the usual period. They expressed the belief that the tumor of the femur had the structure of the parathyroid gland. A month following the fracture a growth, presumed to be metastatic, appeared in the right temporal bone. There were no other osseous changes reported.

In 1926, Hendrioch reported a case of a retrosternal tumor which was removed from a woman aged seventy-one years. This tumor was largely surrounded by the thyroid tissue of the lower pole of the thyroid gland. There was also a smaller tumor in the thyroid tissue of the upper pole. Histologically, the tumor cells resembled parathyroid tissue and a palisade arrangement was frequently noted. In the larger mass, oxyphil cells were absent, the tumor was invading the thyroid gland, there was a departure from the physiologic structure and giant cells were present. No mitotic figures were seen. However, Hendrioch concluded that he was dealing with a malignant tumor arising from the inferior parathyroid of that side and invading the thyroid parenchyma. The smaller tumor he believed to have arisen from an upper parathyroid as an adenomatous enlargement rather than as a metastasis from the larger tumor.

In 1927, Alessandri reported a case of combined thyroid and parathyroid tumor of the right humerus in a man aged fifty-one years. The tumor recurred following resection and interscapulothoracic disarticulation was performed. Although no tumor was found in the neck, the tumor tissue from the arm showed evidence of parathyroid adenocarcinoma as well as thyroid carcinoma and normal thyroid tissue. There was no record of changes in other bones. There was no evidence of recurrence one year after the interscapulothoracic disarticulation.

In 1929, Guy reported the case of a woman aged twenty-nine years. A tumor in the thyroid region had been present for five years and was removed with little difficulty. It measured 8 by 6 by 4 cm. and consisted of closely packed clear cells arranged irregularly and in palisades. The nuclei were large and dark, round or oval and rich in chromatin. Mitotic figures were occasionally seen. A diagnosis of parathyroid adenoma was made. However, within one year of operation three nodules developed in the neck. Biopsy and later excision of these nodules were performed and the tissue removed gave evidence of an actively growing malignant epithelial tumor. Two years and four months after the first operation the masses were much larger and ulcerating and pulmonary metastatic growths were present.

In 1931, Toland described a case in which operation was followed by death with pulmonary metastasis within four months. A woman, aged sixty years, had noticed a swelling in the neck for eight years. At operation the mass was found to be densely adherent to the muscles. It was removed, along with the entire right lobe of the thyroid gland. Microscopic examination revealed irregular atypical cells of various sizes and shapes. The nuclei were large and hyperchromatic and contained a deeply staining nucleolus. The cellular arrangement was irregular. The tumor was considered to be a parathyroid adenocarcinoma.

In 1932, Price and Mowatt described the case of a man, aged forty-nine years, who presented a tumor the size and shape of a hen's egg, behind the angle of the jaw on the left side. Because of the infiltrative invasion of the surrounding tissues, including the internal carotid artery, only portions of the neoplasm could be removed and radium therapy was resorted to. Microscopic examination of the tissue removed revealed one region in which the cells showed palisade formation and a scattered alveolar arrangement with central colloid. The cytoplasm was abundant and finely granular. The nuclei were large, oval and rich in chromatin and contained a deeply staining nucleolus. In the greater part of the tumor the cells showed much vacuolization of the cytoplasm and the alveolar structure was not seen.

Price and Mowatt expressed the belief that this was a malignant parathyroid tumor arising in a parathyroid rest. There was no evidence of hyperparathyroidism. The patient died with metastatic growths about nine months after operation.

In 1934, Hall and Chaffin[36] described the case of a white man, aged forty-six years, who presented himself because of a lump in the neck. The basal metabolic rate was elevated, ranging between +31 and +47 per cent. A cystic tumor of the thyroid gland was removed and this contained a nodule of hyperplastic thyroid tissue in its wall. Behind this tumor was a large mass of liver-like tissue which was also removed. This mass weighed 120 Gm. and measured 11 by 8 by 5 cm. Microscopic examination revealed the mass to be made up of columns and groups of small cells with faintly granular cytoplasm and relatively dark-stained vesicular nuclei. Scattered groups of large, clear cells and a few oxyphil cells were seen. A diagnosis of parathyroid adenoma was made. There was no evidence of hyperparathyroidism.

Sixteen months after operation, three nodules appeared low on the left side of the neck. These were excised. There was gross and microscopic evidence of invasion of muscle. The tumors were made up of atypical epithelial cells arranged in cords and columns in some cases and irregularly in others. Some cells were polygonal with finely granular, moderately eosinophilic cytoplasm. Clear cells and fusiform oxyphil cells were also seen. The nuclei were vesicular and moderately deep-staining and contained one or more prominent nucleoli. Occasional mitosis was seen. There was apparent invasion of the blood vessels and lymphatic vessels by tumor cells. A diagnosis of parathyroid carcinoma was made.

In 1940, Hall and Chaffin[37] reported that this patient had died seven years after the first operation. Necropsy had revealed metastatic growths in the lung and tracheobronchial lymph nodes. The microscopic appearance of the metastatic growths was similar to that of the surgically removed parathyroid tumors.

In 1938, Armstrong reported the case of a woman, aged seventy-one years, who complained of a painless swelling in the right side of the neck. This was found to be stony hard and to extend into the thorax. Operative removal was difficult because of attachment to the internal jugular vein and the sternocleidomastoid muscle. The tumor measured 11 by 11 by 4 cm. The tumor cells showed a varying arrangement with columns, palisading and acinar formation. In some regions the cells were large, closely packed and acidophilic.

The nuclei were well stained. The pathologist reported the appearance to be that of a malignant parathyroid tumor. There was no evidence of hyperparathyroidism.

FUNCTIONING MALIGNANT TUMORS OF THE PARATHYROID GLANDS

Cases of malignant parathyroid tumor causing hyperparathyroidism have been reported much less frequently than cases of malignant parathyroid tumor not causing hyperparathyroidism, only seven such cases having been described in the literature.

The first reports of such a case were made by Wilder and by Wellbrock in 1929. The case which they described has been reviewed as Case I in the present study.

In 1931, Quick and Hunsberger reported the case of a white man, aged twenty-five years, who presented the clinical picture of severe hyperparathyroidism with generalized osteitis fibrosa cystica. An encapsulated parathyroid tumor the size of an olive was found at operation but this was incompletely removed on account of hemorrhage. Microscopic examination showed anastomosing cords of epithelial cells arranged in palisade fashion. The cells showed evidence of active proliferation and a diagnosis of parathyroid hyperplasia was made.

Only slight improvement followed operation so that a second attempt at operative removal of the tumor was made five months later. Microscopic examination of the tissue which was removed at the second operation revealed a picture similar to that seen in the tissue removed at the first operation, but the cells were reported to be irregular in size and to show even greater hyperactivity, suggesting the possibility of malignancy.

In 1933, Sainton and Millot reported a case in which there was evidence of malignant change in an eosinophilic adenoma of the parathyroid. The patient was a woman (age not stated) suffering from generalized osteitis fibrosa cystica which had begun in infancy. There was hypercalcemia. An eosinophilic parathyroid adenoma was removed but her general condition did not improve, secondary calcification increased and a tumor on the maxilla increased in size.

The parathyroid region was re-explored two years later and a small indurated nodule was found in the region from which the adenoma had been removed. This nodule was found to be made up of several small nodules separated by connective tissue. One of these nodules had the histologic appearance of an eosinophilic parathyroid adenoma. The cells were grouped in lobules and some showed a palisade arrangement. The cytoplasm was abundant and filled with fine eosinophilic granules. The nucleus was central, rounded and deeply staining. The structure of the other nodules, however, was much less homogeneous. The cells were irregular in arrangement and varied in staining power. Many cells had deeply staining cytoplasm and a deeply staining nucleus. Mitosis was frequently seen and many large nuclei were evident. In some regions invasion of the surrounding fatty tissue had occurred. Sainton and Millot considered these findings to be clear evidence of malignant change in an eosinophilic parathyroid adenoma.

In 1936, Snell[68] and Mayo[52] reported a case from the Mayo Clinic (Case VII in this series). Severe hyperparathyroidism was relieved by the removal of a large, grade I adenocarcinoma of the parathyroid.

In 1937, Petersma reported a case of hyperfunctioning parathyroid tumor in which he believed the tumor to be malignant. The patient was suffering from an advanced stage of the generalized type of osteitis fibrosa cystica. A small tumor was removed from the region of the lower pole of the right lobe of the thyroid gland. This tumor was composed of clearly outlined cells with water clear cytoplasm and smaller cells with more darkly staining cytoplasm. Tumor cells were found within the blood vessels and the tumor was considered malignant. One year after operation the patient was greatly improved and there was no evidence of recurrence or of metastasis.

In 1939 Meyer, Rosi and Ragins reported the case of a white Greek man, aged fifty-six years, who complained of a painful swelling of the proximal portion of the right little finger and also of having lost forty pounds (18.1 kg.). Physical, laboratory and roentgenologic examinations revealed definite signs of hyperparathyroidism: namely, a firm tumor, about the size of a walnut, to the right of the trachea and just above the sternoclavicular joint, disseminated fibrocystic disease of the bones, renal calculi, a high value for serum calcium, a low value for serum phosphorus and a high value for serum phosphatase. Biopsy of the swelling of the proximal phalanx of the right fifth finger showed the microscopic picture of a benign giant-cell tumor of bone.

A parathyroid tumor was removed from the right side of the neck. It measured 6 by 5 by 4.5 cm. and was moderately encapsulated. Microscopic examination revealed the central portion to be composed of water clear cells and transitional cells separated by a clear stroma. Toward the periphery of the tumor mass the water clear cells were absent and the transitional cells were larger and differed in shape so that they resembled squamous epithelial cells. The nuclei were deeply stained and irregular in size and shape. In focal regions, mitotic figures were seen. Some of these were irregular and showed sharp, plump chromosomes. There was also evidence of invasion of blood and lymphatic vessels. A pathologic diagnosis of a nonhornifying squamous carcinoma of the parathyroid gland was made.

Following operation there was marked subjective improvement; the bones showed evidence of recalcification and the concentration of calcium in the serum fell to within normal limits. However, re-examination fourteen months after operation revealed a hard nodule about 3 cm. in diameter in the region of the right lobe of the thyroid gland. The long bones were again showing evidence of decalcification and laboratory studies revealed a high value for serum calcium, a low value for serum phosphorus and a slightly increased value for serum alkaline phosphatase. Meyer, Rosi and Ragins expressed the belief that they were dealing with a carcinoma of the parathyroid gland which was producing definite signs of hyperparathyroidism.

In 1941, Gentile, Skinner and Ashburn reported the first case of a functioning malignant parathyroid tumor in which definite evidence of metastasis was found. A white man, aged thirty-eight years, suffering from osteitis fibrosa cystica and typical hyperparathyroidism, had a hard nodular tumor on the left side of the neck. This measured 5 by 3 by 2 cm. and was densely adherent to the left lobe of the thyroid gland. The tumor was removed and the cells were found to be polygonal and medium to large. The cytoplasm was oxyphilic to amphophilic and the cell borders were distinct. The nuclei were medium to large, vesicular, hyperchromatic and usually centrally located and commonly contained one or more large nucleoli. (Fig. 1.) Few mitoses were seen. There was evidence of invasion of blood vessels by tumor cells.

The improvement which followed operation was only temporary. Hyperparathyroidism recurred and eight months after the first operation an enlargement of a cervical lymph node on the left side was noticed. This was removed and found to be a metastatic growth from the previously removed malignant parathyroid adenoma. Another lymph node which was removed showed a vascular space filled with tumor cells. (Fig. 2.) The patient was in excellent general condition four years after the second operation.

CASE REPORTS—PATHOLOGIC

The parathyroid tumors encountered at the Mayo Clinic have been studied grossly and microscopically. The clinical aspects of patients from whom the tumors were removed by surgical operation or at necropsy have been described in section I. The case numbers used in that section correspond to the case numbers used in considering the pathologic features. The tumors had been fixed in formalin. Blocks cut from different portions of the tumor were embedded in paraffin. Sections for microscopic examination were cut and stained with hematoxylin and eosin. Other sections were treated with potassium ferrocyanide and hydrochloric acid to demonstrate the possible presence of iron-containing pigment.

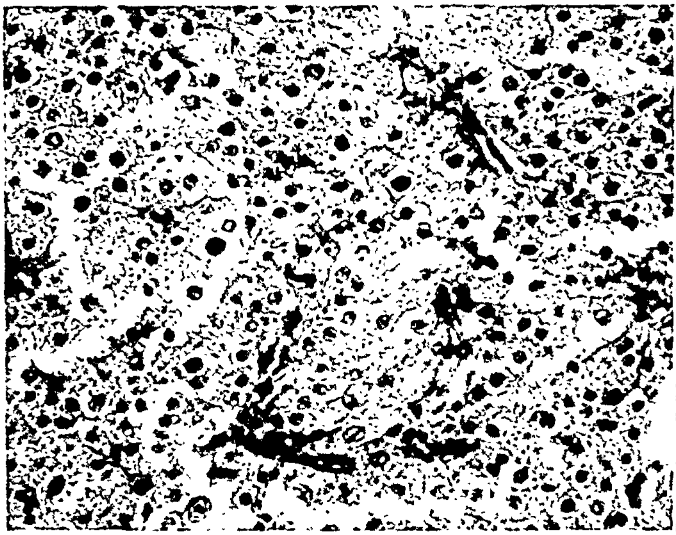

Fig. 1. Parathyroid tumor from the case of hyperparathyroidism reported by Gentile, Skinner and Ashburn. The cellular arrangement is irregular. The cytoplasm is eosinophilic and granular. The nuclei vary in size and shape and many are hyperchromatic. × 500. (Reproduced by courtesy of C. V. Mosby Company Saint Louis, Missouri.)

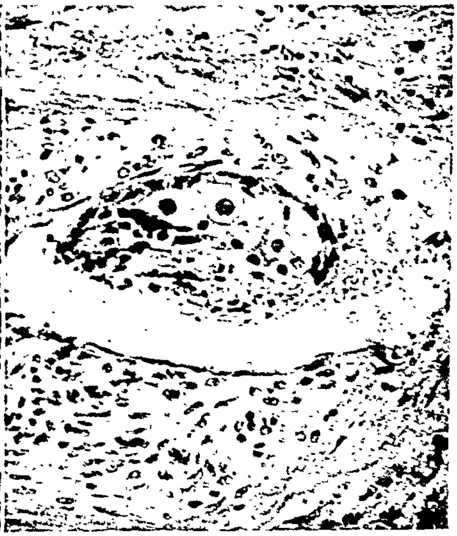

Fig. 2. Section from metastasis to left cervical lymph node showing intravascular tumor mass. Same case as Figure 1. × 515. (Reproduced by courtesy of C. V. Mosby Company, Saint Louis, Missouri.)

Case I. Careful description of the pathologic features of this case was presented by Wellbrock in 1929. The tumor was situated substernally in the inferior pole of the right lobe of the thyroid gland. It measured 5 by 3.5 by 3 cm. and, including a portion of thyroid tissue attached, weighed approximately 40 Gm. The tumor was nodular and bluish gray, varied in consistency in different parts and was surrounded by a thick, fibrous capsule. The cut surface of the tumor revealed four distinct lobulated masses with irregular cystic regions.

Microscopic examination of the tumor disclosed a tendency of the cellular elements to group themselves into an alveolar arrangement. There were many vascular spaces. The cells of the tumor were large, clear and polygonal with poorly staining cytoplasm. They were of the chief and transitional wasserhelle cell types. The nuclei varied in size and stained more deeply than the nuclei of the normal parathyroid gland. Occasional mitotic figures were present. Throughout the tumor were many vesicle-like spaces around which the cells were arranged in palisade formation. The spaces contained thin, faintly staining colloid-like material. Some of the vesicle-like spaces were lined by cells of cuboidal or columnar type. In several regions the neoplastic cells appeared to be invading the capsule. No foam cells or fat cells were seen in the tumor.

Wellbrock considered the tumor to be a malignant adenoma because of the polymorphism of the cells, the hyperchromatic nuclei, the presence of mitotic figures, the apparent invasion of the neoplastic tissue into the capsule and the absence of foam cells and fat. Castleman and Mallory in reviewing this case, considered the tumor to be an adenoma of their glandular and cystic type. We are in agreement with Wellbrock and have classified this tumor as a parathyroid adenocarcinoma grade I (Broders' method).

Case II. Exploration of the neck revealed a tumor lying behind the left lobe of the thyroid gland near the inferior pole. The tumor lay outside the thyroid capsule but was attached to it. It was brownish, measured 1.5 by 1.25 by 1.25 cm. and weighed 1 Gm.

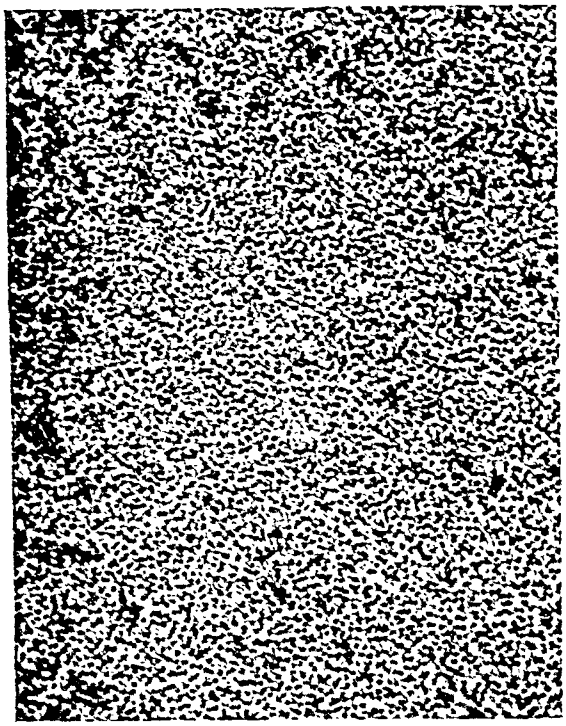

FIG. 3. Case II. Parathyroid adenoma of chief cell type. The cells are small chief cells. The nuclei are small and regular in size and shape. No giant nuclei nor mitotic figures are seen. Neither foam cells nor fat cells are present. There are some regions of pink-staining, colloid-like material (hematoxylin and eosin × 180).

Microscopic examination revealed a very cellular tumor. (Fig. 3.) The cells, which were arranged in masses separated by sinusoids and trabeculae of connective tissue, were small and of chief cell type. The nuclei were small, hyperchromatic and regular in size and shape. There were regions of pink staining colloid with peripheral vacuolization and some regions revealed a palisade effect. Neither giant nuclei nor mitotic figures were seen. There was a marked absence of the normal parathyroid fat. Sections stained with potassium ferrocyanide and hydrochloric acid revealed an iron-containing pigment along the trabeculae of connective tissue. This pigment was both intracellular and extracellular. Because of the small, regular, evenly staining nuclei and the absence of mitotic figures and giant forms, this tumor was considered to be an adenoma of chief cell type.

CASE III. The tumor was situated on the posterior surface of the right lobe of the thyroid midway between the superior and inferior poles and above the point of entrance of the inferior thyroid artery into the gland. It was not embedded in the thyroid gland but was connected to the fascia surrounding it. The tumor projected into the groove between the trachea and the esophagus. It was soft and darkish gray and presented a mottled appearance. On removal it measured 3 by 2.5 by 2.5 cm. and weighed 10 Gm.

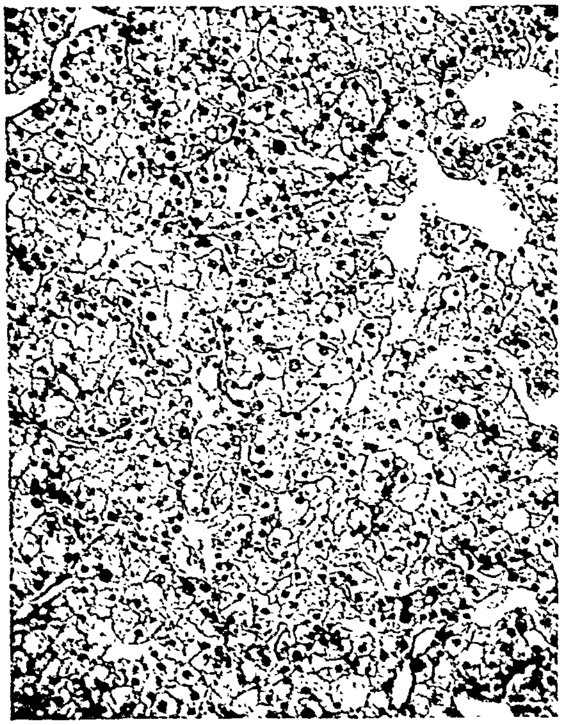

FIG. 4. Case IV. Parathyroid adenocarcinoma grade I of clear cell type. The cells are large, clear or wasserhelle cells arranged in masses but with a tendency to alveolar formation. The nuclei are irregular in size and shape and are hyperchromatic. Many are placed eccentrically in the cell. Large endothelial-lined sinusoids are prominent. The resemblance to hypernephroma is marked (hematoxylin and eosin × 180).

Microscopic examination revealed the tumor to be composed of cells resembling chief cells but with regions of larger, clear or wasserhelle type cells. The cellular arrangement was of alveolar type. The nuclei were irregular in size and shape and were hyperchromatic. Many nuclei contained prominent nucleoli. Some giant nuclei were present. Occasional mitotic figures were seen. At some points the cells gave the appearance of invading the capsule. There were many dilated sinusoids. Regions of pink-staining colloid were present and at some points about five to thirty cells could be seen surrounding a connective tissue core, giving a pseudoglandular effect. Staining for iron revealed iron-containing pigment along the trabeculae of connective tissue and in relation to the dilated sinusoids. Because of the irregularity of size and shape of the nuclei, the densely staining chromatin network, the giant nuclei and occasional mitotic figures, this tumor was considered to be a low grade I adenocarcinoma of the parathyroid.

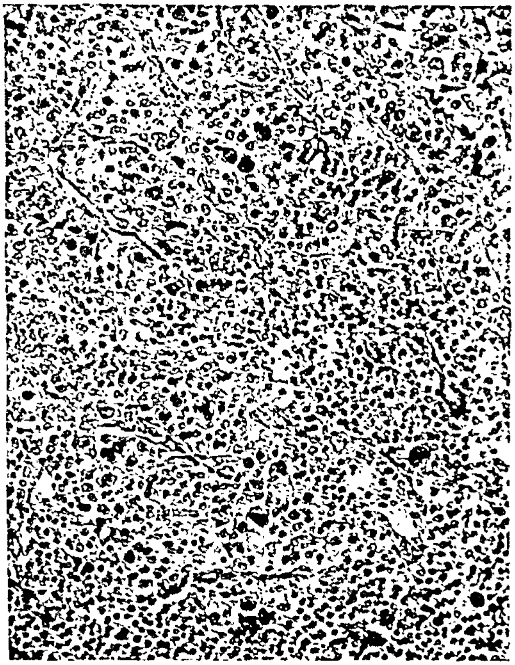

FIG. 5. Case V. Parathyroid adenocarcinoma grade I. Both chief and oxyphil types of cell are present. The cellular arrangement is irregular and the nuclei are hyperchromatic and irregular in size and shape. Giant nuclei and mitotic figures are seen (hematoxylin and eosin × 180).

CASE IV. A tumor was found lying behind the right lobe of the thyroid gland in the groove between the trachea and the esophagus. On removal it measured 3 by 1.5 by 1 cm. and weighed 5 Gm. A portion of the right lobe of the thyroid gland was also removed. The surgical pathologist reported the thyroid tissue as showing parenchymatous hypertrophy with regenerative hyperplasia and thyroiditis grade I.

Microscopic examination revealed the tumor to be made up of large cells with clear cytoplasm. (Fig. 4.) The cells were arranged in masses although in some regions an alveolar arrangement was apparent. The nuclei were eccentrically placed, hyperchromatic and irregular in size and shape. Many nuclei had prominent nucleoli. No mitotic figures were seen. There were numerous small cystic spaces lined by these wasserhelle cells. Large endothelial-lined sinusoids were prominent. Regions of colloid with peripheral vacuolization were occasionally seen. There was no evidence of capsular invasion. No chief or oxyphil cells were seen. Because of the irregularity of the size and shape of the nuclei associated with the prominent nucleoli and the densely staining chromatin network, this tumor was considered to be a grade I adenocarcinoma of clear cell type.

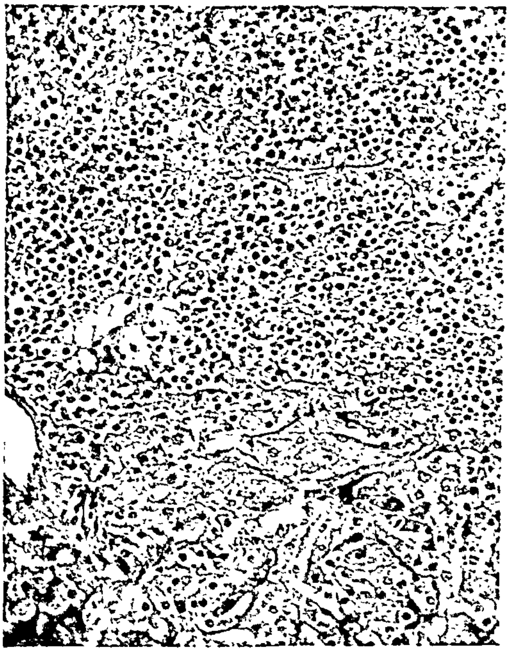

FIG. 6. Case VIII. Parathyroid adenocarcinoma, grade I. The contrast between tumor cells of the chief cell type and those of the oxyphil cell type is clear. The cellular arrangement is irregular and the nuclei vary in size, shape and staining power (hematoxylin and eosin × 180).

CASE V. The parathyroid tumor was found extending substernally on the right side behind both the trachea and the esophagus. It was irregularly ovoid and definitely encapsulated and the capsule was anchored at only one point near the inferior pole of the right lobe of the thyroid gland. At this point the tumor received its blood supply from the inferior thyroid artery. The tumor was yellowish brown, making a marked contrast with the color of the thyroid tissue. The tumor was ruptured during removal but all the tumor tissue and the capsule were removed. Before rupture the tumor was estimated to measure 6 by 5 by 4 cm.

Partial removal of the right lobe of the thyroid gland was performed and the surgical pathologist reported this to show cystic degenerating colloid and fetal adenomas in a hypertrophic parenchymatous colloid thyroid with thyroiditis grade 1 (on a basis of 1 to 4, in which 1 designates the mildest and 4 the most severe condition).

Microscopic examination of the tumor revealed most of the cells to be of chief cell type but there were scattered regions of oxyphil cells. (Fig. 5.) The cells showed an irregular alveolar arrangement. There were many endothelial-lined sinusoids. The nuclei were hyperchromatic and irregular in size and shape and the nucleoli were prominent. Mitotic figures and giant nuclei were seen. The evidence of malignancy was more definite in the oxyphil than in the chief cells. The tumor was considered to be a high grade 1 adenocarcinoma of the parathyroid.

CASE VI. A tumor was found lying behind the right lobe of the thyroid gland midway between the superior and the inferior pole and attached to the thyroid capsule. The tumor was blackish brown. On removal it measured 2 cm. in diameter and weighed 5 Gm.

Microscopically, the tumor was found to be made up of large clear cells with an irregular arrangement. There were occasional pale oxyphil cells. There was great vascularity with large endothelial-lined sinusoids. The nuclei were deeply stained and varied grossly in size and shape. The nucleoli were prominent. There were tumor giant cells scattered throughout. Mitotic figures were frequently seen. The histologic picture was that of a higher grade of malignancy than that of the preceding cases and this tumor was classified as a grade 2 adenocarcinoma of the parathyroid, of predominantly clear cell type.

CASE VII. The surgical and pathologic aspects of this case were presented by Mayo in 1936. A tumor was found on the right side of the neck, extending substernally into the posterior mediastinum and behind the trachea. It was soft, encapsulated and surrounded by a network of veins. On removal, it measured 6 by 6 by 5 cm. and weighed 101 Gm. The cut surface was chocolate colored and showed cystic regions. The surgical pathologist reported the tumor to be a grade 1 adenocarcinoma of the parathyroid.

Microscopically, the tumor cells were seen to be of the clear cell type and fairly uniform in size. There was one region of pale oxyphil cells. The nuclei varied considerably in size and shape and some giant nuclei were present. Many of the nuclei contained excessive chromatin. Mitotic figures and prominent nucleoli were occasionally seen. At some points there was apparent capsular invasion. The cellular arrangement was of diffuse type. Regions of pink-staining colloid with peripheral vacuolization were scattered throughout. This tumor was considered to be a grade 1 adenocarcinoma of the parathyroid.

CASE VIII. A tumor was found lying behind and elevating the right lobe of the thyroid gland. It was situated near the lower pole. On removal, this tumor measured 2.5 cm. in diameter and weighed 7.1 Gm.

Microscopic examination revealed the tumor to be made up predominantly of chief cells with an alveolar arrangement. There were also regions of pale oxyphil cells (Fig. 6) and large clear cells. The nuclei were larger and more hyperchromatic than those seen in the normal parathyroid gland and were irregular in size and shape. A few mitotic figures were seen. Throughout the tumor were clear spaces, some lined by endothelium and others by parenchymal cells. This tumor was considered to be a grade 1 adenocarcinoma of the parathyroid.

CASE IX. At necropsy, a tumor was found in the neck near the lower pole of the right lobe of the thyroid gland. It was yellowish brown, measured 4 by 2 by 2 cm. and weighed 4.2 Gm. The pathologist reported the tumor to be a parathyroid adenoma.

On microscopic examination the tumor was found to be made up of chief cells with some regions of wasserhelle cells and other regions where the cytoplasm was of oxyphil type. The cells were for the most part arranged in a diffuse manner but in some regions there was an alveolar arrangement. The nuclei were large, hyperchromatic and irregular in size and shape. Nucleoli were prominent and mitotic figures were seen. The tumor was considered to be a grade 1 adenocarcinoma.

CASE X. A tumor was found on the posterior aspect of the left lobe of the thyroid gland, near the superior pole. On removal, it measured 2.9 by 2.3 by 1.4 cm.

On microscopic examination, the cells of the tumor were found to be arranged very irregularly. Cells resembling chief cells, large, pale oxyphil cells and also wasserhelle cells were present. The nuclei were hyperchromatic and showed great variation of size and shape. Many giant nuclei were present. Tumor giant cells and mitotic figures were seen fairly frequently. A few pathologic mitotic figures were seen.

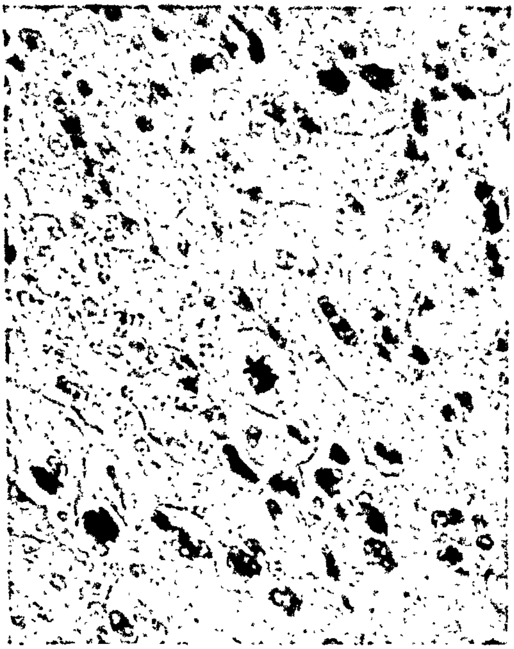

Fig. 7. Case x. Parathyroid adenocarcinoma grade 2. The cells are irregularly arranged. The cytoplasm of many of the cells contains oxyphil granules. The nuclei vary grossly in size and shape and are hyperchromatic. Giant nuclei are present and one cell is shown undergoing pathologic mitosis (hematoxylin and eosin × 400).

(Fig. 7.) There were numerous large sinusoids and hemorrhagic regions, often associated with pigmentation with an iron-containing pigment. This tumor was considered to be a grade 2 adenocarcinoma.

Case xi. A dumbbell-shaped tumor was found at the lower pole of the left lobe of the thyroid gland. It projected substernally. On removal, it measured 3.5 by 2 by 1.5 cm. and weighed 6 Gm.

Microscopic examination revealed the tumor to be made up of irregularly arranged clear cells and scattered oxyphil cells. Sinusoids and hemorrhages were prominent. There were regions of pink-staining colloid with peripheral vacuolization. The nuclei were large and hyperchromatic and markedly irregular in size and shape. Many mitotic figures and a few tumor giant cells were seen. (Fig. 8.) This tumor was considered to be a grade 2 adenocarcinoma.

Case xii. A tumor was found dorsal to the right lobe of the thyroid gland outside of the thyroid capsule. It measured 3 by 1.5 by 1.5 cm. and differed in color from the thyroid tissue. Removal was readily accomplished after division of a branch of the right inferior thyroid artery.

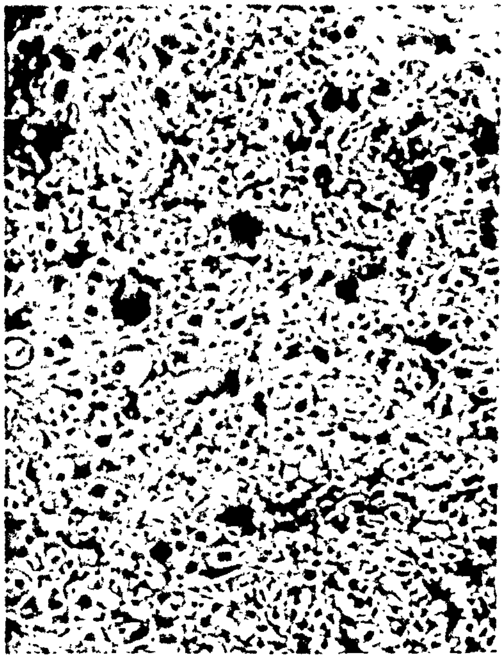

Fig. 8. Case xi. Parathyroid adenocarcinoma grade 2. Both clear cells and oxyphil cells are present and in a markedly irregular arrangement. The nuclei show gross variation in size and shape and staining power. Tumor giant cells can be seen (hematoxylin and eosin × 180).

Microscopic examination revealed a rim of normal chief cells partially surrounding the tumor. In the tumor the cells showed an irregular arrangement with regions of rosette formation and pink-staining colloid. No oxyphil or wasserhelle cells were seen. The nuclei showed densely staining chromatin networks and were irregular in size and shape and staining power. Some nuclei were distinctly granular and many showed prominent nucleoli. Occasional mitotic figures were seen. This tumor was considered to be a high grade 1 adenocarcinoma of the parathyroid.

Case xiii. A tumor was found situated at the inferior pole of the left lobe of the thyroid gland. It lay outside the thyroid capsule and received its blood supply from the left inferior thyroid artery. It was readily removed with its capsule. The tumor weighed 4.23 Gm. and measured 2.4 cm. in diameter.

Microscopic examination revealed the tumor to be made up of cells resembling chief cells, arranged diffusely. No oxyphil or wasserhelle cells were seen. The nuclei were larger than the nuclei seen in the normal parathyroid and stained more deeply. Nucleoli were not prominent but occasional mitotic figures were seen. In some regions the cells were arranged as a loose cellular network. Regions of pink-staining colloid with peripheral vacuolization were scattered throughout. A prominent feature was the invasion of the capsule by tumor cells. (Fig. 9.) This tumor was considered to be a low grade I adenocarcinoma of the parathyroid.

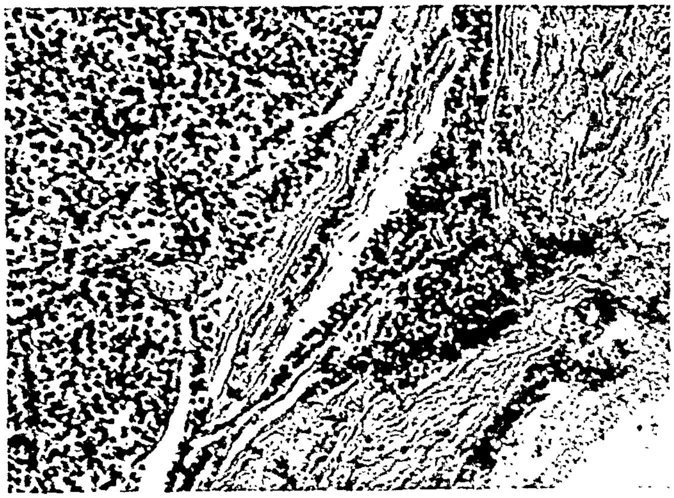
Fig. 9. Case XIII. Parathyroid adenocarcinoma grade I. The tumor cells are invading the capsule (hematoxylin and eosin ×180).

Case XIV. Exploration of the neck for a parathyroid tumor gave negative results. Subsequent exploration of the mediastinum through a sternal splitting approach revealed a tumor in the left anterior mediastinum. It was oval, encapsulated and readily removed. It weighed 5 Gm. and measured 4.5 by 2.5 by 1 cm.

Microscopic examination revealed a general alveolar arrangement of cells with a darkly staining nucleus and relatively clear cytoplasm. There were scattered regions of oxyphil cells and wasserhelle cells. (Fig. 10.) The nuclei were irregular in size, shape and staining power. The nucleoli were prominent and many nuclei appeared granular. Giant nuclei and mitotic figures were scattered throughout the tumor. This tumor was considered to be a grade I adenocarcinoma of the parathyroid.

REVIEW OF CASES WITH COMMENT

Weight of the Tumor. In ten of the fourteen cases, the tumor was weighed shortly after removal, before section and fixation. The average weight of the tumors in these ten cases was 18.2 Gm. The greatest weight was 101 Gm. and the least weight was 1 Gm. Castleman and Mallory found an association between the volume of the tumor and the severity of the

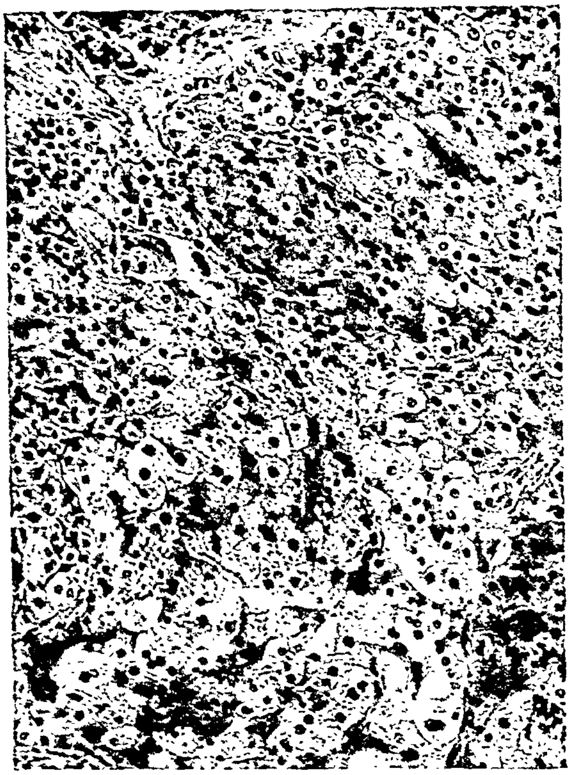
Fig. 10. Case XIV. Parathyroid adenocarcinoma grade I. Chief cells, wasserhelle cells and clumps of oxyphil cells can be seen. The cells are arranged irregularly in this section. The nuclei are irregular in size, shape and staining power (hematoxylin and eosin × 180).

hyperparathyroidism as judged by the average preoperative concentration of calcium in the serum. The larger tumors were associated with higher concentrations of calcium in the serum. Cope has applied this finding when searching the neck for a parathyroid tumor. He stated that if the elevation of the level for serum calcium was minimal, the surgeon should realize that any adenoma would be small and perhaps difficult to find. On the other hand, if the concentration of calcium was more than 14 mg. per 100 cc. of serum the tumor should be large enough to be palpated or to displace other organs and be discovered readily. He also expressed the belief that the converse is true; if a small adenoma was identified in a patient with a moderate or high elevation of the serum calcium level, then a second adenoma should be looked for.

Table 1
THE RELATION BETWEEN THE WEIGHT OF THE TUMOR AND THE AVERAGE OF THE PREOPERATIVE VALUES FOR SERUM CALCIUM IN TEN CASES OF HYPERPARATHYROIDISM

Weight of Tumor, Gm.	Cases	Average of Preoperative Concentration of Calcium, Mg. per 100 Cc. of Serum
Less than 5	3	14.85
5 to 9.9	4	14.35
10 and more	3	14.3

In this series of ten cases, no proportional relation between the weight of the tumor and the preoperative value for serum calcium could be established. (Table 1.)

Position of the Tumor. Nine (64.3 per cent) of these tumors were situated on the right side of the neck or mediastinum and five (35.7 per cent) on the left. In one case the tumor was within the right lobe of the thyroid gland, was nodular and extended into the superior mediastinum. In the other thirteen cases, the tumor was outside the thyroid parenchyma, either attached to or free from the thyroid capsule.

In seven cases the tumor was situated at the lower pole of the corresponding thyroid lobe. In three of these cases the tumor projected through the superior into the posterior mediastinum. In one of these latter cases, the tumor lay behind the trachea and the esophagus. In four instances, the tumor lay behind the corresponding lobe of the thyroid gland midway between the upper and lower poles, while in one case the tumor was found behind the upper pole. In another case the tumor lay in the left anterior mediastinum and could be removed only after the sternum had been split.

In 1941, Cope reported that of forty-nine adenomas of the parathyroid he had found nine in the mediastinum (18 per cent); five (10 per cent) were in the anterior mediastinum, four (8 per cent) in the posterior mediastinum. In the present series of fourteen tumors, four were found in the mediastinum (28.6 per cent); one (7.2 per cent) was in the anterior mediastinum, and three (21.4 per cent) were in the posterior mediastinum.

Color. In all cases in which the color of the tumor was recorded before fixation in formalin, a brown, grayish brown or bluish gray color was noted. Absence of the normal parathyroid fat was the rule.

Capsule. All the tumors showed a definite capsule. In four instances (28.6 per cent) there was evidence of invasion of the capsule by tumor cells.

Type of Tumor. In this series there were no cases of generalized parathyroid hyperplasia. In no case were multiple tumors found although in Case 1 lobulation was marked. Careful attention to the cytologic detail in this series of fourteen tumors resulted in one (7.2 per cent) being classified as a benign chief cell adenoma. Ten (71.4 per cent) were classified as grade 1 adenocarcinomas of the parathyroid and three (21.4 per cent) as grade 2 adenocarcinomas of the parathyroid.

Cytologic Features. Each of the three principal types of cells which have been described in the parathyroid parenchyma was seen in the tumors. Most commonly each of the cell types was found in each tumor; however, in one instance, a grade 1 adenocarcinoma, all the tumor cells were large, wasserhelle cells and the appearance closely simulated that of a hypernephroma. There did not appear to be any relation between the clinical picture and the type of cell predominating in the tumor.

Cytologic evidence of malignancy was seen in chief cells, oxyphil cells and wasserhelle cells. Such evidence included irregularity of the size and staining power of the nuclei, densely staining chromatin networks, giant nuclei, mitotic figures with pathologic mitoses and prominent nucleoli. In addition, there was absence of the normal parathyroid cell patterns with, in some instances, invasion of capsule and blood vessels by tumor cells.

In strong contrast to this finding of evidence of malignancy in 92.8 per cent of a series of parathyroid tumors causing hyperparathyroidism is the report of Cope on fifty-eight adenomas seen at the Massachusetts General Hospital. He stated that in no instance was there any microscopic evidence of malignancy. He asserted that carcinoma of the parathyroid is a rare disease and that in no reported case had hyperfunction been proved. In commenting on Snell's report (concerning Case VII in this series) Cope said, "The report of carcinoma in a gland giving rise to hyperfunction is not beyond question." Similarly Castleman and Mallory classified the tumor in Case I of this series as a benign tumor of glandular and cystic type. Jaffe also asserted that there was some doubt as to the possibility of a carcinoma existing in the parathyroid gland and criticized some of the cases reported as such. To the contrary are the reports of Quick and Hunsberger, Sainton and Millot, Petersma, Meyer, Rosi and Ragins and Gentile, Skinner and Ashburn. Meyer, Rosi and Ragins found unquestionable evidence of malignancy of the parathyroid in a case of hyperparathyroidism. After operative removal of the tumor the hyperparathyroidism abated but the tumor recurred locally and manifestations of hyperparathyroidism reappeared.

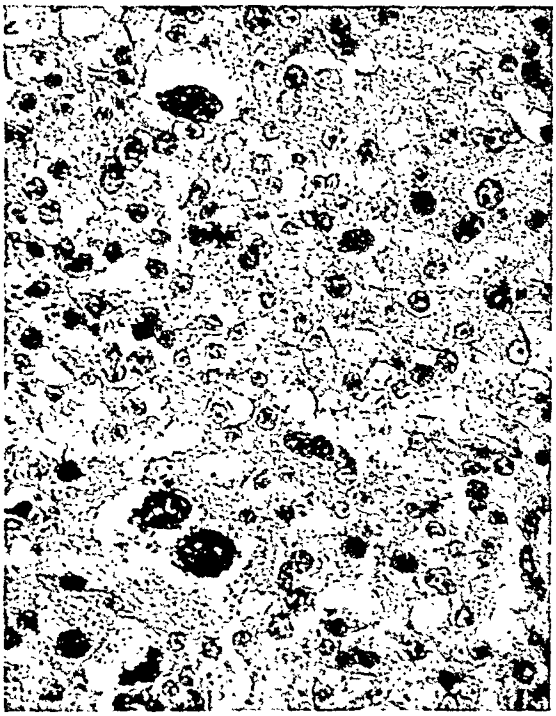

Fig. 11. Case x. Parathyroid adenocarcinoma grade 2 for comparison with Figure 1. The cells are irregularly arranged and many contain granular eosinophilic cytoplasm. The nuclei are hyperchromatic and show gross variation of size and shape. Giant nuclei are present. The tumor pictured in Figure 1 metastasized to a cervical lymph node. However, the histologic picture of the tumor pictured in Figure 11 is that of a greater degree of malignancy (hematoxylin and eosin × 400).

In the case reported by Gentile, Skinner and Ashburn, hyperparathyroidism recurred after removal of a malignant parathyroid tumor. This was relieved by operative removal of a metastatic growth in a cervical lymph node.

In no case in the series under study did metastasis or local recurrence occur, but the histologic features of the tumors, at least in the three cases showing grade 2 adenocarcinoma, were as frankly malignant as those of the tumors described by Meyer, Rosi and Ragins and Gentile, Skinner and Ashburn (Figs. 1, 2 and 11.)

It seems probable that local infiltration and distant metastasis would have occurred more frequently were it not for the fact that these tumors, because of the hyperparathyroidism which they produced, were removed before local or distant spread had occurred. The average duration of the disease to the time of operation was 3.9 years. This is not a long period in the history of other low grade malignant tumors such as papillary adenocarcinomas of the thyroid.

The question is not a purely academic one. The malignant nature of the tumors makes their complete removal imperative. Cope, being skeptical of the development of carcinoma in the remnant of a parathyroid tumor, has stated that subtotal resection rather than complete removal of a tumor may sometimes be necessary in order to avoid life-endangering tetany. Because so many of these tumors are malignant and because the postoperative tetany can be controlled by administration of calcium and vitamin D we are unable to agree with Cope. Furthermore, although transient tetany was a troublesome complication in most instances in this series, in only one instance did persistent tetany occur.

SUMMARY

There have been many reports of nonfunctioning malignant parathyroid tumors and of functioning parathyroid adenomas. However, there have been only seven previous reports of functioning malignant parathyroid tumors producing hyperparathyroidism. In this paper fourteen cases of clinical hyperparathyroidism, proved to be due to functioning parathyroid tumors, are presented. In two cases the termination was fatal while in twelve, the results of operative treatment were excellent.

Stress has been laid on the widely divergent clinical pictures which patients who have hyperparathyroidism may present. It has been shown that any one symptom or sign—clinical, laboratory or roentgenologic—should not be regarded as decisive. Single findings of concentrations of calcium less than 12.5 mg. per 100 cc. of serum were encountered in 30.8 per cent of cases of proved hyperparathyroidism. Attention has been drawn to the importance of bearing in mind the relation between the serum protein level and the serum calcium level.

Depression of the value for serum phosphorus, measured as inorganic phosphate, is the rule in those cases without gross impairment of renal function.

The serum alkaline phosphatase level is elevated in proportion to the degree of involvement of bone.

The Sulkowitch test provides a rough estimate of the presence or absence of excess urinary excretion of calcium. Considered alone, it is not diagnostic of hyperparathyroidism.

The changes of bone in hyperparathyroidism appear to be an index more of the duration of the disease than of its severity.

According to our experience the incidence of renal lithiasis in hyperparathyroidism is about 60 per cent.

In thirteen (92.8 per cent) of the fourteen cases here presented the tumor showed cytologic evidence of malignancy. Two of these latter cases have been reported previously.

No correlation was found to exist between the weight of the tumor and the degree of hyperparathyroidism as measured by the concentration of calcium in the serum before operation.

The average weight of the tumors was 18.2 Gm. They were encapsulated and usually were brown. Four (28.6 per cent) were in the mediastinum, three being in the posterior mediastinum and one in the anterior mediastinum.

Cytologic evidence of malignancy was seen in chief cells, oxyphil cells and wasserhelle cells. Such evidence included irregularity of the size and staining power of the nuclei, a densely staining chromatin network, giant nuclei, mitotic figures, pathologic mitoses, prominent nucleoli, irregular cellular arrangement and invasion of the capsule and blood vessels by tumor cells.

The type of cell predominating in the tumor did not appear to affect the clinical picture.

Stress has been placed on the necessity for complete operative removal of parathyroid tumors.

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MANAGEMENT OF POSTOPERATIVE URINARY TRACT COMPLICATIONS*

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WE have been afforded the opportunity of acting as urologic consultants for the Department of Surgery at the Lahey Clinic which does approximately 10,000 surgical procedures yearly. At this time we will attempt to outline some of the common problems we have encountered, presenting a general resumé rather than an exhaustive statistical study. All too frequently the postoperative urinary tract complications supersede the patient's original complaint, and upon the treatment of these complications may depend the outcome of the case. Therefore, even though valuable contributions to the subject of postoperative urinary tract complications have been made in the literature, a review seems indicated.

COMPLICATIONS

The three most common complications which still plague the general surgeon are *postoperative urinary retention*, *postoperative urinary tract infection*, and *postoperative urinary suppression*. These are frequently related and may occur in any order, but often develop in the order given.

Postoperative Urinary Retention. Since postoperative urinary retention may be dependent upon the anesthesia, the type of anesthetic, its depth and length are important. It is generally recognized that marked depression of sensory perception from any anesthetic permits vesical distention; and it would seem that local field block, spinal and inhalation anesthesia, in the order given, least affect the ability to urinate. At the Lahey Clinic, the use of inhalation anesthesia is limited to head, neck and chest cases, spinal anesthesia being employed for all abdominal and lower extremity operations. However, small amounts of inhalation anesthetic are given if apprehension occurs. A recent survey at the Clinic showed that 17 per cent of patients had to be catheterized after anesthesia.

In pelvic surgery the denervation of the bladder and the relocation or final malposition of the bladder constitute a well recognized factor. The distortions of the bladder seen on the cystogram and on cystoscopic examination, particularly after hysterectomy, advancement procedures and interposition operations are so definite that one is surprised when the patient can urinate at all. (Fig. 1.)

Removal of the lower bowel allows definite bladder distortion. (Fig. 2.) With removal of the rectum, the bladder loses its posterior support and practically hangs from the bladder neck down into the hollow of the sacrum. A definite acute angle is formed by the posterior urethra or vesical lip and the floor of the bladder. In many instances, the trigone is unable to correct this angle; and the detrusor muscle, moving about in space, so to speak, with no fixation of its base, is only weakly effectual. This malposition, with only minor disturbances in the balance of the autonomic nervous system, predisposes to urinary retention. This bladder difficulty is much more frequent and severe in the presence of even the slightest amount of prostatic enlargement; and since men in the age group in which prostatic enlargement is most common also are most susceptible to carcinoma of the rectum, many of these patients fall to the care of the urologist.

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We have proved by cystometric determination, and numerous other investigators have done likewise, that these bladders demonstrate such changes as markedly diminished sensory component, increased bladder capacity, decreased intravesical pressure, and absence or definite diminution of the maximal voluntary pressure curve. (Fig. 3.) The anatomic and neurogenic lesions affecting the bladder often are happily transient, this organ having the faculty of adjusting itself readily to unusual positions and disturbances of innervation.

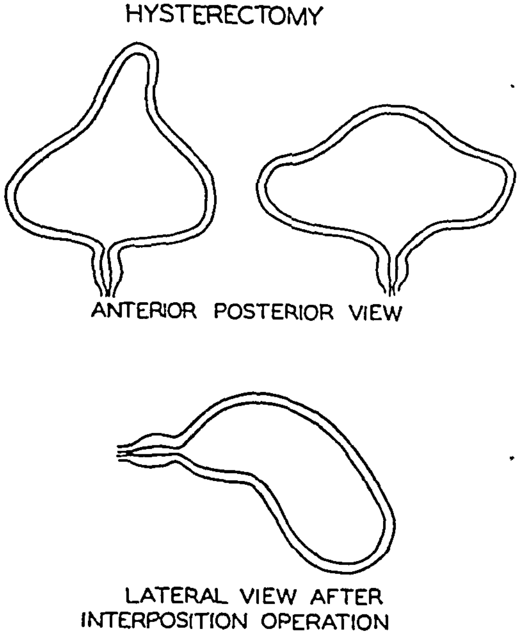

Fig. 1. Change in shape and position of bladder after hysterectomy.

Postoperative retention due to true anatomic obstruction of the urethra is often either latent or overlooked. This is particularly true following repair of a hernia or a hemorrhoidectomy in a person past fifty years of age, when the reason for the hernia or hemorrhoids was not ascertained. Even on rectal examination, median lobe enlargement, contracture of the bladder neck, and urethral stricture may be overlooked.

Also, many obese persons lack the necessary abdominal wall component (Bauchpressor), and large ventral hernias or separation of the recti prevent them from tensing these muscles. It is frequently necessary to advise the nursing staff that if these patients are put in Fowler's position, they will be able to urinate.

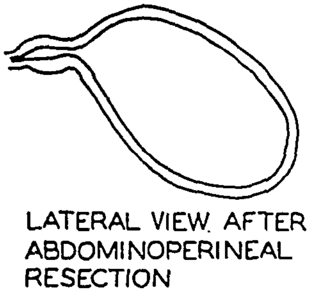

Fig. 2.

The *prevention* of postoperative urinary retention should be our first thought. Our impression is that if the house physician or the resident staff always appreciated that the urinary bladder undergoes decompensation just as truly as does the heart, patients would not be allowed to become distended so that their bladders held 1,000 to 1,500 cc. If the term "postoperative bladder decompensation" were attached more often to the consultation sheet, perhaps closer attention would be paid to the condition of the patient's bladder. If it were the custom more often for the physician to put his hand under the sheet and feel the patient's bladder, at least for the first forty-eight hours, fewer cases of postoperative retention would be encountered.

Postoperative decompensation may be said to occur when the bladder is allowed to reach the level of the umbilicus. In modern times, most patients receive parenteral fluids after abdominal surgery; consequently, in the first twelve hours 3,000 cc. or more of fluid may be given. In the absence of shock, the use of hot blankets and hot water bottles, with resulting loss of large amounts of body fluid, now is being omitted; consequently much of the fluid intake may be expressed in urinary output. It is manifestly impossible for a patient to void after eight hours of retention, since by this time the bladder is so huge that the bladder wall has lost its ability to contract in response to the ordinary sensations. Normal persons taking 3,000 cc. of fluid have to void more often than every eight hours. To expect a patient who has had an anesthetic, has an abdominal incision, and is lying in bed, to void only once in eight, ten or even twelve hours, as is so frequently recorded in the postoperative instructions, needs no comment. The order to catheterize at intervals longer than six hours is distinctly unphysiologic.

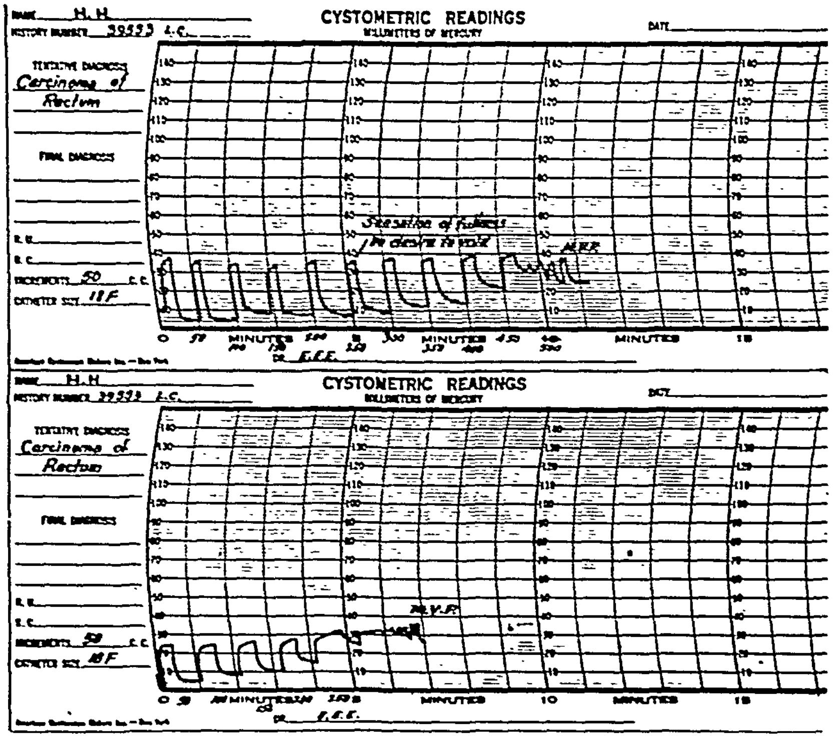

Fig. 3. Cystometric readings after abdominoperineal resection of the rectum.

The use of drugs is perhaps the most widespread method of combatting retention, those that stimulate the parasympathetic nerves being the most useful. The most familiar is prostigmine, used alone or in combination with morphine. Recently, Hand[2] of this Clinic has used the combination of prostigmine and morphine because of the recent reports of its potentiating effect. The addition of prostigmine, 0.5 mg., 1/130 gr., or 1 cc. of a 1:4,000 solution, to morphine, gr. 1/8, will result in therapeutic effects similar to those resulting from the use of morphine, gr. 1/4.

Our clinical investigation tends to confirm the laboratory findings to a moderate degree. In a recent series limited to gallbladder and stomach surgery, retention occurred in only approximately 6 per cent of the patients. Prior to this, retention occurred in 15 to 20 per cent of the patients. Furthermore, this combination (morphine, gr. 1/8, and prostigmine, gr. 1/130) by subcutaneous injection, relieves pain within only ten to fifteen minutes, produces an effect which lasts for four to five hours, and does not dull the sensorium too much. Because of its apparent value, it is now being employed routinely at the Clinic.

Doryl, an acetylcholine derivative, has also been employed; however, recently a death occurred in a young man in whom no other reason for death than the use of the drug could be found. The dose given was supposedly 0.25 mg. Rupture of the bladder in patients with diverticula or with marked degeneration of the bladder itself is within the realm of possibility.

The prophylactic instillation of various drugs into the bladder locally is an attempt to increase the irritability of the bladder and to overcome the depression of the sensory component produced by the anesthetic, postoperative medication and fear. The use of mercurochrome by Woodruff,[5] Helfert[3] and others is a more recent application of this.

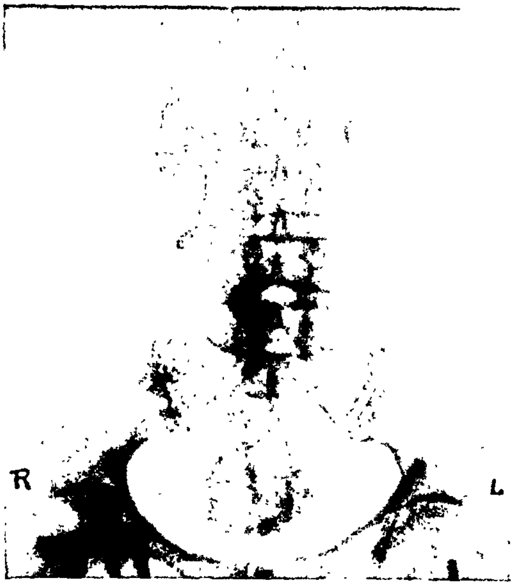

Fig. 4. Excretion urogram after right ureteral ligation. The right side shows hydronephrosis and hydro-ureter. The left side is normal.

Our practice for the avoidance of bladder decompensation follows: The patient is catheterized every six hours until the residual urine is 60 cc. or less. After each catheterization, 2 oz. of ½ of 1 per cent aqueous mercurochrome is instilled. This method reduces the residual urine more quickly than intermittent catheterization without an irritant solution. If after twenty-four hours the residual urine is not reduced appreciably, the patient is placed on closed drainage with an indwelling catheter; and the bladder is irrigated every three hours with 2 per cent boric acid or 0.8 per cent sulfanilamide solution. Once having established the decompensated bladder, the patient is allowed to remain on closed drainage for a minimum of five days, and then is given a trial without a catheter and tested for residual urine every six hours as before. Usually one such course of management will suffice. In borderline cases, when the bladder is not lessening its residuum well enough, we have used 0.5 to 1 cc. of doryl one-half hour before catheterization as an added stimulus to the contractile power of the detrusor muscle. This is used, however, only in the absence of any obstructive lesion. Also, immediately upon starting the catheterization program, the patient is given 0.25 Gm. of sulfathiazole by mouth four times daily.

Under this plan of treatment, fluids can be forced without concern; and we have yet to see a resulting upper urinary tract complication. This plan has been invaluable in those patients with advancement of the bladder or cystocele-correcting procedures. In the past some of these patients have broken down their repair because the residual urine was not checked or the bladder was allowed to distend to an enormous degree because the ability of the bladder to empty itself was not determined.

A patient who has undergone abdominoperineal surgery or who is in the age group of prostatic disease, after two trials of this management, is given a cystoscopic examination and any bladder neck obstruction is corrected. If no mechanical obstruction is found, cystometric studies are done to detect an undisclosed nerve lesion.

In the male with a urethral stricture, the passage of a filiform into the bladder and tying it in place is often of assistance. This method, which is applied by older urologists, is unknown or unappreciated by many of the younger men. It results in less damage to the patient than forcibly dilating a stricture to allow spontaneous voiding or to enable a catheter to be put in place.

Postoperative Urinary Tract Infection. It seems inevitable to link postoperative urinary tract infection with bladder atony or a persistent undiscovered residual urine. The type of surgical patient in whom this is most frequent and is least appreciated is the woman with a large cystocele. Many multiparous women carry a bacteriuria which flares up into a clinically evident urinary tract infection on bad postoperative management.

Sulfonamides in small prophylactic doses, totalling 1 Gm. a day, should be used more often, since this amount will control postoperative urinary tract infection. When we are consulted preoperatively concerning a patient with prostatic hypertrophy who will undergo surgery for a malignant condition elsewhere in the body, which has taken precedence over the prostatic condition, we prescribe 0.25 Gm. of sulfathiazole four times a day. If the patient is easily upset by this drug and especially if he is undergoing surgery of the gastrointestinal tract, the use of enteric-coated tablets materially avoids the nausea which, despite popular belief, does not always seem to be due to a central effect. For the patient in whom both forms of sulfathiazole elicit a reaction, sulfadiazine or sulfamerazine may be prescribed, in the same dosage. When all the sulfonamides are attended by reaction, mandelamine (0.5 Gm. four times a day), although less effective, will be useful.

Postoperative Urinary Suppression. The fact that true partial or complete anuria is present rather than retention must always be established. The classification into prerenal, renal and postrenal forms permits of a workable clinical arrangement.

The search for loss of excessive body fluids through vomiting, hemorrhage, diarrhea and gastrointestinal fistula is required. Periodic blood pressure readings to rule out shock, vascular accident and coronary occlusion, of course, must all be kept in mind. Post-transfusion anuria in the presence of hemorrhage and shock may confuse the picture greatly so that a definite diagnosis at times is difficult. The widespread use of the blood bank demands adequate crossmatching. Reaction in Rh-negative recipients given repeated transfusions from Rh-positive donors is now an appreciated cause of anuria.[4] In this situation, the treatment consists of transfusion with Rh-negative blood, and the use of alkali to prevent precipitation in the renal tubules.

Chronic Bright's disease always has seemed to us a dangerous condition in an obese person undergoing abdominal surgery and having some degree of postoperative shock. Recently an obese male with chronic Bright's disease was in partial shock following cholecystectomy and developed oliguria. The urine had a low specific gravity; and the blood pressure, which previously had been elevated, approached normal. It was only after the use of 50 per cent glucose and intravenous fluids that the urinary output became normal. Even with a diminished output, the fluid intake must at all times be maintained. Also, in the presence of edema, so long as there is output, fluids must be continued. We have not recommended or seen any benefit result from renal decapsulation and denervation.

We are now all familiar with the notorious offenders, namely, the sulfonamides, as a cause of anuria. Our experience indicates that if sulfadiazine is given without adequate fluids to a patient with some degree of acidosis or an acid urine, some degree of diminished urinary output must be expected. In postoperative patients without too many factors to be controlled, sulfathiazole seems to be more soluble. Our consultations for this form of diminished output have been almost always for sulfadiazine and rarely for sulfathiazole; however, it would seem that no trouble should result from either in the small dosage of 1 Gm. a day. We have had to cystoscope and catheterize the ureters of five patients with crystallization of sulfadiazine, but have avoided this complication in quite a few other patients by an increased intake of fluid and alkalinization. If the non-protein nitrogen is not approaching a critical level, the use of parenteral fluids may ward off manipulation.

Under postrenal causes for diminished output of urine, we are impelled to discuss surgery in the pelvis. Hysterectomy is a notorious offender in injuries to the ureter. Bilateral ligation of the ureters is a tragic occurrence if allowed to go unrecognized. Our experience in injury to the ureter during gynecologic surgery is limited to the unrecognized ligation of a ureter which finally established a communication to the vagina on the eighth postoperative day. The management of this case is representative of the plan we had long entertained for dealing with such a situation. Since this woman had undergone a hysterectomy, the strain of childbearing was past. After proving by excretory urograms that the other kidney was normal (Fig. 4), and by attempting to catheterize the suspected side and establishing the site of the difficulty, a nephrectomy was done. The patient's postoperative stay in the hospital was prolonged, possibly two weeks; however, she was not subjected to returning for a hazardous plastic operation and the many necessary cystoscopic trials for patency thereafter, which might also have been an extreme economic burden.

Many unilateral ligations occur in patients in whom the anatomy has become distorted by intraligamentous fibroids and cysts. This type of pathologic condition must be kept in mind when a stormy course follows pelvic surgery.

Over a period of years we have followed several patients with endometrial implants on the ureters in whom some injury to the ureters during pelvic surgery was thought likely. We have noted narrowing of the ureters, but this did not progress, as interpreted by the excretory urogram. We believe that attempts to dilate an apparent narrowness might lead to an intractable upper urinary tract infection.

We would like to interject a comment here in regard to the ureteral atony and ureterectasia which result when large segments of the ureter are exposed, especially in lower bowel surgery, and the importance of avoiding this procedure if possible.

It is instructive to review a case in which a ureter was cut purposely by Dr. R. B. Cattell of our staff when removal of a section of the ureter was necessary because of involvement by a carcinoma of the rectosigmoid. When the ureter was cut, a No. 12 soft rubber catheter was passed down the distal segment and up into the proximal. An end-to-end anastomosis was done by tacking the cut ends together with interrupted fine catgut sutures. An indwelling catheter was placed in the bladder, as is customary in all patients undergoing this form of surgery. The posterior wound was drained and since this was adequate, no other drainage was provided intra-abdominally. The patient's postoperative course was not unusual. On the twelfth day a cystoscopic examination was done and the ureteral splint was removed. On checking the urogram three months later, only the slightest dilatation of the ureter in an otherwise normal upper urinary tract was found.

We must confess that in the light of present knowledge we would have allowed the ureteral splint to remain in place at least three weeks and preferably longer. If any complication had marred the removal of this catheter, we intended to remove the kidney so as to shorten the patient's postoperative course and not subject him to additional manipulation when the eventual prognosis at best was not promising.

We recognize that prolonged ureteral splinting and complicated plastic procedures may at times not be feasible, and that the surgeon is confronted with the problem of attempting a surgical bridge for the patient's postoperative course at a time when the question of his recovery is critical. Dr. Cattell's idea was that the simplest form of establishing ureteral continuity was demanded, and that if the patient could be tided over until his second or third week, this result would be achieved; and that any other radical surgery then could be handled by the urologist without adding an unnecessary burden in the first critical days.

We recently were consulted in another case for advice regarding the severance of a ureter which was involved in a carcinoma of the rectosigmoid. The ureter was ligated and dropped back into place. The patient had had a urinary tract infection, and he was placed on more than the usual amounts of sulfathiazole postoperatively. The resulting hydronephrosis and fever were controlled until the second week when a nephrectomy was necessary because of fever, flank pain and lack of progress. The important point is that this patient was tided over his acute surgery and management of his complicating urologic problems was simplified.

Large Bowel Surgery. Several years ago, one of us (E. E. E.)[1] analyzed 750 cases of large bowel surgery, because of the high incidence of associated genitourinary complications. Nearly all the patients had a malignant condition, and because the operability rate of carcinoma of the rectum was calculated to be 85 per cent, it was assumed that the extensive lesions and the poor risk would produce a comparative rise in the genitourinary complications. All patients undergoing abdominoperineal resection, as well as many of those with sigmoidal and colonic lesions, had a catheter in place and were on constant drainage. Since it was impossible to determine preoperatively the type of procedure necessary, most of them were handled by inlying catheter.

From this study it was concluded that genitourinary complications after large bowel surgery are most common following removal of the rectal portion, 74 per cent of the whole group having postoperative difficulty in emptying the bladder. This is perhaps due to the fact that the portions of the genitourinary tract most frequently involved by carcinoma of the rectum and sigmoid are the prostate gland and the bladder. In five patients in whom resection had been performed, the process invaded the prostate gland after operation and produced obstruction which necessitated resection of the bladder neck. These complications may be so serious that they definitely prolong the patient's convalescence.

The patients with postoperative difficulty in emptying the bladder seem the most important. Of the fifty-three males who had resection of the rectum, thirty-two had sufficient difficulty to require revision of the bladder neck. All these patients had some symptoms prior to operation. The question of preoperative correction of the vesical neck had been raised previously, but we believe that postoperative correction is wiser since some of these patients with difficulty preoperatively may get along sufficiently well after bowel surgery to avoid two major surgical procedures in quick succession. Also, the removal of obstruction does not eliminate possible paralysis of the detrusor muscle, which nearly all these patients have to some degree after abdominoperineal surgery. Another factor is that the reaction following transurethral operations done after the abdominoperineal resection is much less, due to destruction of the blood supply to the prostate gland and the walling off of the lymphatic system. Definite bladder paralysis for longer than two months has occurred in only two patients; and in only six patients of our series was it necessary to maintain tidal drainage longer than three to four weeks. A suggested clinical classification of detrusor paralysis follows:

1. Pure detrusor paralysis from parasympathetic denervation
   - (a) A mild form cystometrically evident in large numbers of patients the first week following operation
   - (b) A severe form necessitating prolonged tidal drainage, present in a small number
2. Mixed forms of detrusor paralysis in combination with:
   - (a) Vesical neck obstruction
   - (b) Almost complete loss of anatomic support and lack of fixation
   - (c) Inherent resistance in the male urethra.
3. Vesical neck obstruction alone

Ureteral dilatation which apparently is not due to obstruction at the bladder neck has been noted in some of these patients. While isolation of the ureters is important to the general surgeon, needless dissection is a mistake, since it deprives the ureters of blood supply and also denervates them.

The abdominoperineal patient routinely is handled by an inlying catheter. The urethral catheter of the Foley type is inserted the night before surgery and closed drainage is instituted. In the patient in whom difficulty is anticipated, the inlying catheter should not be removed until he is able to sit up. Many of these patients incur damage to the upper urinary tract in the form of pyelonephritis at the time of removal of the catheter. Since this is the crucial period, these patients must not be allowed to become overdistended. Patients voiding small amounts, even though they are comfortable, should be catheterized and if more than 2 oz. of residual urine is present, the catheter should be reinserted for a few more days. The usual plan of catheterizing patients with ordinary postoperative retention should be followed, and thus the bladder is not allowed to revert to complete atonicity. Many times the patient's clinical progress in regard to the genitourinary system may be retarded during this crucial period by a co-existing infection, which may be exceedingly stubborn.

Many patients, especially males, even with an adequate bladder neck, continue to have residual urine. We have been impressed with the fact that the removal of the slightest amount of bladder neck obstruction will allow such a patient to urinate freely. Since many patients continue to have pyuria after dismissal, although they have no symptoms, persistent urinary check-ups should be done and small doses of urinary antiseptics prescribed.

SUMMARY

The three most common postoperative urinary tract complications are retention, infection and suppression. The causes of these manifestations are reviewed, and our experience in their management is presented. Particular attention is given to the urinary problems attending pelvic and large bowel surgery. The consulting urologist to a busy surgical service can render invaluable aid by relieving the clinical picture in a patient already overburdened with other serious difficulties.

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MOTION STUDY IN SURGERY

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OVER a period of years, increasing efforts have been made to set standards for the practice of surgery and its various special divisions. Surgical organizations and specialty boards have made steady progress in recognizing and certifying qualified specialists. While every surgeon cannot be expected to be of outstanding ability, still there is a certain degree of proficiency which is essential to the practice of surgery. This raises the query as to what constitutes a good surgeon and as a corollary the question as to what constitutes good surgery.

Even in professional athletics it is not easy to define the qualities which make outstanding performers. In golf and in tennis it is that intangible something called form; in horse-racing it is called class. All players on a ball team are not stars but must have sufficient talent for the league in which they play.

Good surgery requires thorough examination, accurate observation, a wide knowledge based on experience and carefully planned and timely intervention aimed at the greatest possible restoration of normal function.

A good surgeon is endowed with personal aptitude, mechanical dexterity, sound judgment, and ability to make rapid decisions in the face of unexpected situations. These qualities are fundamental and must be supplemented by adequate basic training and thorough knowledge of technical procedure.

This study is concerned only with the competent surgeon. It is assumed that he knows what to do and how to do it. It considers, therefore, not the choice of operation or methods but rather is concerned with mechanical factors, motions, materials, and their use.

Because of the introduction of so many variations into surgical procedure during the past half century, it is time to stand off and survey the whole picture, appraising individual factors in their relation to the entire pattern.

The trend toward simplification of equipment and procedure had advanced rapidly and further acceleration is current under the stimulation of war time conditions. Shortage of professional man power and limitation of supplies can be largely overcome by application of sound principles of standardized practice.

Work simplification has been a major factor in industrial management since the pioneer time studies originated by Dr. F. W. Taylor in 1881 for the purpose of rate setting. Subsequently motion study was developed by F. B. and Lillian Gilbreth for the purpose of improving methods. In 1915, F. B. Gilbreth made an analysis of hospital efficiency from the standpoint of a non-medical process engineer. It had been his belief that because of the importance of the work and because of the specialized medical training of the operating personnel he would find here the greatest perfection of method and efficiency of any technical organization.

After a study of surgical methods in use at that time, he reported having found a waste so enormous that it was unequalled in his experience. Since that time only a small number of papers have been contributed on this subject. Progress has been made, however, despite the fact that the medical mind instinctively avoids industrial and commercial standards. For this there is no valid reason. The object of all work simplification and standard practice studies is to consider all factors involved and to determine the one best way to undertake a procedure. These factors include standardization of equipment, economy of motion, prevention of physical fatigue, and shortening of the time factor. The latter is to be in no way construed as a plea for speeding up operative procedure. It is utterly impossible to standardize in minutes the time required by a varied group of men for the performance of an appendectomy. It is similarly not necessary to undertake an appendectomy with a scissors, hemostat, needle and sutures as has been done. Oversimplification of equipment has no merit of itself; nor has the development of high speed technic if such a method sacrifices accuracy and thoroughness or induces undue fatigue.

It has been said that a man who will not consider change is an old man. The study of an assortment of surgeons of various age groups shows that at an early stage of their careers they have become victims of habit. Since change usually runs counter to established custom, mental habit is the basis of resistance to change. Like the door to a room, the mind permits entrance of new ideas only when it is open.

The sturdy individualism of surgeons in general makes distasteful a constant repetition of the same process and one wonders what would be the reaction of the surgeon were he to become a cog in the great wheel of industrial organization and spend an entire day punching drill holes in pieces of sheet metal. Yet, by such methods has our great supremacy in industry been founded.

When a new idea or method offers an increase in efficiency or the same efficiency with less loss of motion, it should be tried out at once. Revamping of surgical methods requires a mental house-cleaning on the part of the crew. It involves close scrutiny of existing methods with a view to their efficiency, simplicity and economy. It is obstructed largely by the lack of understanding of the value of such work and by the natural resistance to change from established habit.

One effective method of overcoming resistance is to subject objectors to a time and motion study of their work. The results are often instructive and convincing.

The object of this study is to analyze present methods and to suggest changes which will permit surgical operation to be accomplished with the smallest number of instruments, with the simplest motions, and in the shortest practicable time. In industrial processes a similar objective but different products are concerned. Industrial time and motion studies deal with a great volume of uniform products, so that the production process is purely repetitive. On the other hand, the human body is not stamped in a mould. It is living tissue in which allowance must be made for variation of structure both in health and disease. Nevertheless, accuracy and efficiency can be improved by a study of mechanical methods and their application to the science of surgery. It is estimated that 30 to 70 per cent of man and motion capacity are ordinarily not utilized in industry. Motion studies made over a period of several years indicate that a similar situation exists in surgery.

Mechanical methods should be reviewed in an attempt to determine whether any step should be omitted entirely, whether any individual habit motions are being perpetuated and whether any steps can be simplified without loss of accuracy. No attempt is made to rigidly limit technical motions for the sake of uniformity alone. Mechanical methods should be surveyed from the standpoint of simplification of setup and reduction of excess motions and consequent fatigue. Speed results from long practice due to familiarity with instruments and the development of habits of sequence, but it must not be attained at the expense of increased mental strain. The fastest method is not necessarily the best method and may not always result in a saving of time; but, in general, reduction in time consumed, if accomplished without added effort, will reduce the incidence of fatigue and improve the result. The surgeon and associates should be so welded into a unit that their process reactions are standard for the team which they form. The equipment must be correctly placed, the tools must be comparatively few, arranged in obvious sequence, and should be handled with the easy familiarity of long use.

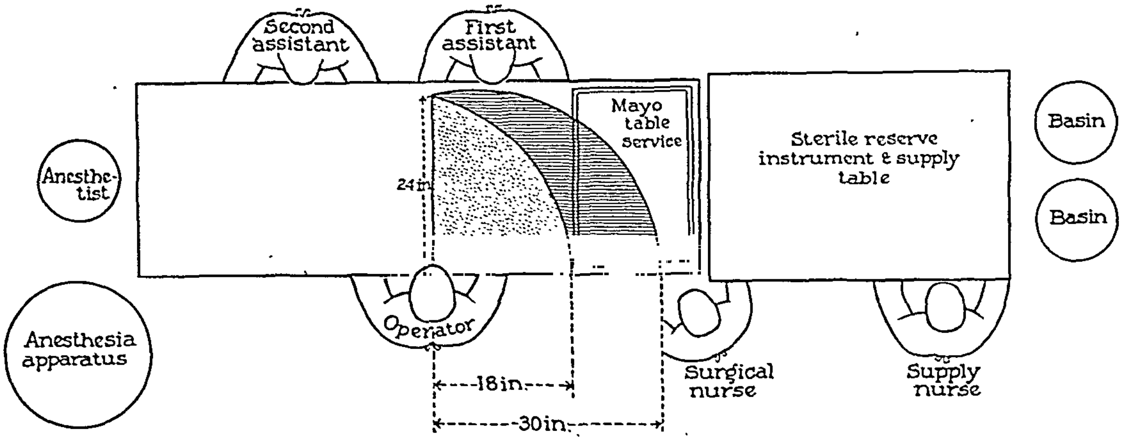

Fig. 1. Maximum working arc for right and left hands, right side. Right hand area shaded; left hand area stippled. Use of hands within these areas does not involve reaching or twisting body. Note that equipment is set up in straight line assembly.

The focal point of every operation is the surgeon, and all activity must radiate from that central point. It is essential that equipment and assistants be coordinated to permit direct and rapid action without hesitation, delay or obstruction.

Universal fundamental laws have been developed and proved by investigators in the industrial field. These laws are axiomatic and may be adapted to the practice of surgery.

Mechanical methods in surgery, as in industry, may be divided into two general classes: (1) Those concerned with set-up and equipment, (2) Those concerned with motion activity. The laws involving set-up and equipment can be reduced to four:

1. Instruments should be the simplest in design and fewest in number that will permit carrying out of the entire procedure. One of the bugbears of modern surgery is the multitude of specially designed instruments with slight variations. This is a costly and confusing practice. Skill is acquired and dexterity improved by constant practice with a few tools. Even the golf associations have found it necessary to limit the number of clubs which may be used in tournament play. Equipment already owned should be used whenever possible and new instruments should be added only when they perform a real function.

2. Locate the most frequently used materials within normal reach and in position which permits easy grasping. Three phases are involved in the use of instruments: acquisition, use and disposal. In setting up the instrument table it is important to provide definite and fixed stations for instruments and materials which should be within reaching range of the person who is to handle them. More frequently used instruments should be most accessible and should be placed within the normal working arc. This includes a semicircular area within reach of the forearm. (Fig. 1.) Less frequently used instruments may be located within the maximum working arc,

Table I

RELATIVE STRENGTH OF FINGERS, HANDS AND ARMS

	Pull in Lbs.	10 Lb. Pull Relaxes in
Thumb	15	30 sec.
Index finger	19	45 sec.
Middle finger	22	45 sec.
Ring finger	15	15 sec.
Little finger	12	5 sec.
Wrist	25	90 sec.
Forearm	140	22 min.

an area reached by the fully extended arm. Instruments placed outside that range must be handled by a second person, otherwise the element of clumsiness will enter. Instruments should be prepositioned on the table and should be separated sufficiently from adjacent objects to permit easy finger grasping. Curved hemostats may lie flat but flat instruments should be elevated on one end or stood up in a bowl for quick pick up.

These principles apply to the handling of instruments by the surgeon and assistants as well as to the nurses in charge of service and reserve supply tables. The number of instruments on the service table should be small and should be such as are used regularly. Those less frequently used may be kept on the reserve table which holds extra sponges, duplicates of the commonly used instruments and those which are used only infrequently. An instance was noted in which rake retractors were set up on the supply table in a hundred consecutive operations without ever being used. Obviously they were improperly located and should have been on the reserve table if used at all.

Each instrument should be disposed of as its use is completed and the operating table itself should always be free of instruments and sponges. The operating table is not an instrument table and should not be used as such. There should be designated on the service table a specified place for the disposal of soiled instruments. A folded towel may be placed in the front center of the service table and as soon as a soiled instrument is deposited in this area it is removed by the instrument nurse, cleaned and repositioned or discarded. It has been found helpful to keep on the same table a small deep cup for the reception of used needles and when each needle is deposited in the cup it is acknowledged by the table nurse who calls, "needle," a rule rigidly enforced. An orderly table is a pretty accurate index of the experience and ability of the operator and the co-ordination of the crew.

3. Arrange instruments in proper sequence and so prepositioned as to eliminate or reduce the search, find and select factors. Placement of instruments should be carried out with regard to the order and frequency of their use. The extremes to which this may be extended is illustrated by the celebrated surgeon, now gone, whose operating crew spent hours setting up his instrument tables so that each instrument was placed in the order of its proposed use and no instrument was ever used a second time. This necessitated the use of hundreds of instruments in complicated cases and was carried out to the extent of using separate needles and thread for each of the closely placed interrupted skin sutures. Such lengths of caution are unnecessary and only clutter up the tables. An extra knife for skin incision is essential, as any knife which has penetrated the deep bacteria bearing layers of the skin should be discarded to prevent bacterial implantation in the uninfected deeper layers; but instruments not contaminated may be used again.

Handling of instruments should involve the least possible conscious effort. This presupposes an unvaried location of instruments in positions of natural sequence so that the hand automatically picks up or receives the instrument in a position ready for use. This should be accomplished without taking the eyes off the field of operation. With a well trained and permanent operative crew this is a simple matter; but when assistants are being frequently changed, it becomes necessary to use some means of communication. Hand signals of a not too complex type answer satisfactorily, but in an ordinary operation such signals will seldom be required. When signals are used they should simulate the shape or function of the instrument called for, and it is unnecessary for signals to attain the complexity of a Morse Code. Twelve hand signals have sufficed to cover the most commonly used tools and all others are called for by name. (Fig. 2.)

4. Operating room equipment should be placed so as to provide fixed stationary positions for the personnel. It is essential that walking about be kept at a minimum during operation. Fixed positions save time and reduce the danger of infection. A single circulating supervising nurse should be the only one to move about and her services should be necessary only during preparation, after completion of the operation or when special supplies and equipment are needed.

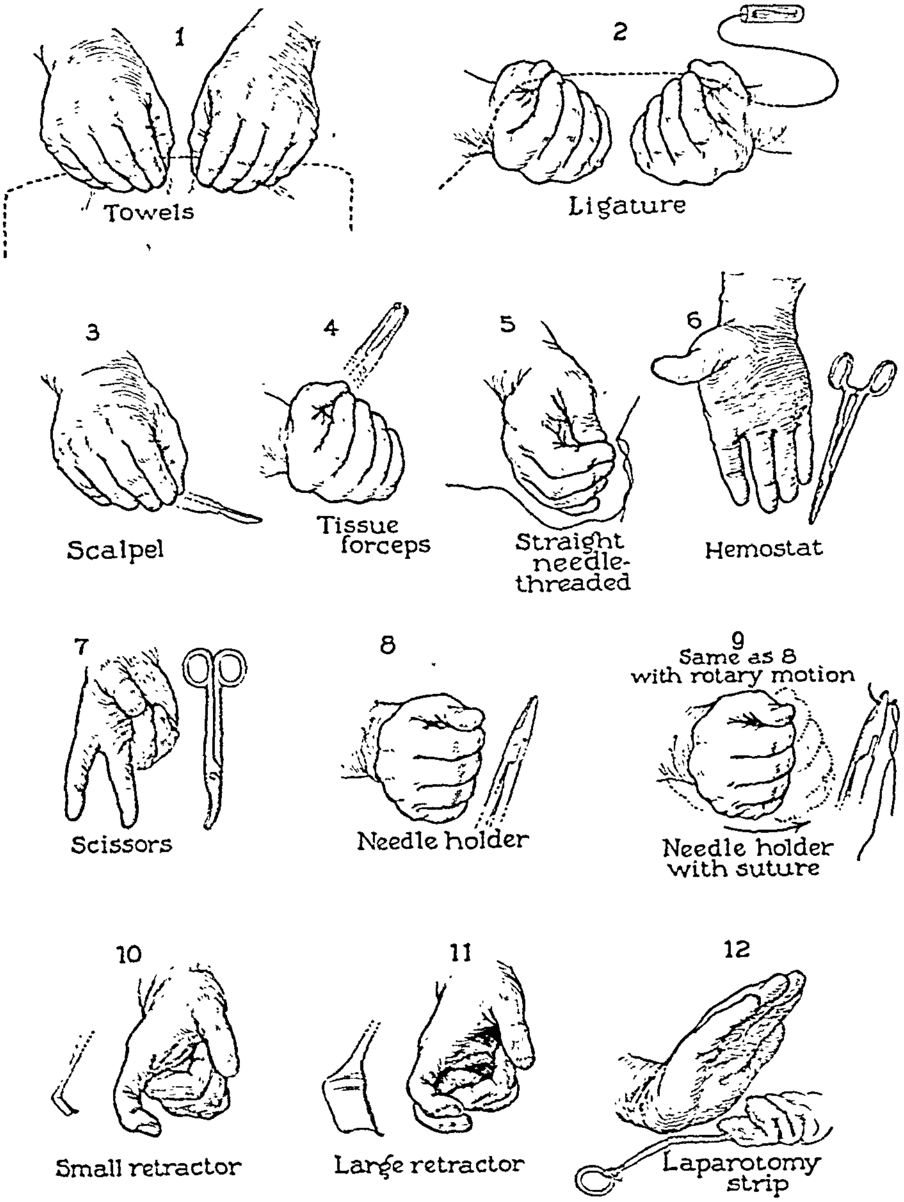

FIG. 2. Hand signals used to call for commonly used instruments. Others are called for by name.

Study of operating and supply table set-up shows many kinds in use. Lawrence and Berry designed a circular or arc surgical assembly based on the range of normal grasping areas. Although theoretically an ideal plan, the system seems to restrict the free area about the operative field when more than one surgical assistant is used, and the supply nurse seems to be placed dangerously near to the anesthetist. Familiarity with the arrangement might well accustom one to its use but it requires the installation of specially designed tables, a handicap which precludes its general acceptance at this time.

Of the many arrangements tried out, a straight line assembly has proved most satisfactory. The operating and supply tables are set up end-to-end and two basin stands are placed at the far end of the supply table. A small adjustable service instrument table of the Mayo type is placed above the feet of the patient. The surgeon stands to the right of the operating table with the first assistant directly opposite. The second assistant may be stationed on either side as circumstances warrant. The table nurse stands to the right of the surgeon and directly in front of the small instrument table. The supply nurse is at her right, directly in front of the reserve supply table. This gives the surgeon unobstructed access to the instrument table with his right hand and leaves the disposal area within reach of his left hand. The nurses, standing side by side, always face the sterile instrument and supply tables and are out of the way of the other members of the team. (Fig. 1.)

5. Provision should be made for adequate lighting, and the height of the tables should be such as to minimize reaching and bending. The operating table should be of such height that no one is obliged to lean over, a fault which quickly induces fatigue and lessens muscular efficiency. The patient should be so placed and the table so tilted as to take advantage of the forces of gravity. Thus, in pelvic surgery the Trendelenburg position will permit cephelad displacement of the small intestine which in the erect position is carried entirely within the pelvis. Reversed Trendelenburg position with a dorsal lift will rotate the liver anteriorly and do away with the necessity for liver traction in exposing the gallbladder. Left lateral tilting of the table will displace the intestine and make exposure of an adherent retrocecal appendix a simple instead of a difficult maneuver.

Provisions must be made for adequate lighting, as good illumination is a prerequisite to satisfactory visual perception. Light must be glare-free and provide a focusing device to illuminate deep areas within the body. It must provide for emergency current in case of current failure and must be safe for use in the presence of explosive anesthetic gases.

The object of process study is to find the fewest motions which will do a given piece of work in the best way. Six laws are applicable to Motion Activity:

1. *Delay factors must be eliminated or reduced to a minimum.* Analysis of motion processes should provide a basis for simplifying work and eliminating factors which hinder, obstruct or delay its completion. Each step is considered in the light of what is being done, why it is being done, its relations to preceding and subsequent steps and to the entire operation.

Circumstances sometimes make delay inevitable but most causes of delay are avoidable. These result from mechanical failure, faulty choice of method, or personal ineptitude.

Delay due to personal shortcomings may be due to unfamiliarity with a set technic, lack of surgical judgment or inability to make mental decisions with necessary alacrity. The last manifests itself by a hesitant and indecisive approach and by deviation or shifting of the point of surgical attack from one place to another without good reason for such change of front.

Fatigue results from incorrect posture, long continued fixed traction, and from the use of cross arm motions beyond the normal work range. Stooping and twisting of the body are common errors of posture and the greatest single factors in wearing down physical reserve. Body twist occurs almost always when a surgeon crosses his arms beyond the normal working arc instead of using the other hand to transport instruments. It is permissible to cross either arm in front of the body within normal range. Beyond that the instrument should be picked up with the left hand and transferred to the right in an interrupted straight line motion or the instrument should be passed by the table nurse to a point within the normal forearm range.

The backs of the operating crew may be assumed at all times to be potential danger areas and must therefore be kept away from all sterile materials. Turning the back to the table to explore the gallbladder with the left hand is an example of faulty technic. Placing assistants so close to each other as to have elbows coming in contact or placing them within close range of the anesthetist may break the entire chain of aseptic technic. The practice of resting the weight of the forearms and hands on the body of the patient is common and should be carefully avoided. Attention is forcibly called to this habit when abdominal surgery is performed under infiltration anesthesia.

Delay due to mechanical failure results from improper arrangement of equipment, faulty choice of handling of instruments or incorrect distribution of work between the operator and his assistants.

Work processes should be so arranged that the surgeon is spared all steps which can safely be taken over by his assistants. Ligation of vessels in non-vital areas may be done by the assistants and these procedures may be so spaced that the work of the operator is not continuous, thus giving him a few moments of respite while they are being taken care of. Such rest periods definitely reduce the fatigue factor. Too often the operator forgets the weariness involved in maintaining long continued traction. On rare occasions when such traction is necessary a change of hands holding the retractor will lessen fatigue.

Delay results also from failure of method. Here the offending factor may be a wrong choice of method or a lack of direct and continuous execution of an otherwise satisfactory method.

It is desirable to complete any operation in the shortest time required by the individual operator. One surgeon may complete an appendectomy in fifteen minutes whereas another may require thirty minutes. It must be recognized that ability to work rapidly is not evenly distributed among surgeons; and although precision training tends to level off this inequality, it can never be entirely overcome. No single time standard can be set for different men, but use of uniform methods will permit each man to complete the work in the shortest time compatible with his talents. Motion too rapid for the capacity of an individual is highly dangerous as it induces hasty and inaccurate work.

2. *Distribute motion in accordance with the inherent capacities of fingers, hands and arms.* The characteristics of arm and hand motion permit classification into four groups:

(1) Finger motion alone with wrist, elbow and shoulder stationary is the most accurate for fine detail, requires the least time and effort and so produces the least fatigue. With prolonged or heavy use, however, fingers tire more quickly than hands and hands more quickly than forearm. Finger motions are used in opening and closing hemostats and in feather edge dissections with a knife.

Training will increase the agility and dexterity of finger movements up to a certain point but this maximum point varies widely in different individuals.

(2) Wrist motion is slower than finger motion and somewhat less accurate but permits a much firmer grasp and can be used against more solid resistance. Wrist motion is usually employed in making a free incision or in suturing with a needle holder.

(3) Forearm motion uses the elbow as a pivot and is slower and stronger. Resultant fatigue varies as the motion is vertical, horizontal, circular or torsional. It is used typically in exploration and in heavy through-and-through suturing with a needle holder.

(4) Shoulder motion is the slowest and least delicate type and is most likely to disturb postural balance. It is best adapted to prolonged heavy work such as traction.

Finger motions are more accurate than those controlled by the forearm, and motions involving the upper arm and shoulder are most suitable when strength is required. (Table 1.)

3. *Use each hand for the purpose for which it is best fitted but do not utilize one hand to the exclusion of the other.* It is necessary to determine whether either hand is overworked or underworked. In industrial processes both arms are used to equalize the load wherever possible. In surgery this can be followed only to a limited extent because of the specialized functions of the right hand. However, it is possible to transfer elemental motions to the left hand so that the work is more equally divided. The work load will then be assigned to left and right hands, not equally from the point of fatigue, but according to the special capacities which each possess.

The left hand should come in for a full share of work and particularly should it be used for the more fatiguing activities. It should not, however, be considered only as a vise with which to hang on to a heavy instrument. Since it is less practiced and therefore less adept, a considerable degree of training is necessary before delicate motions can be undertaken with it. It must be remembered also that locked instruments such as scissors and hemostats are designed for right-handed use and in using them with the left hand a special technic is required. It is inadvisable to attempt to develop true ambidexterity as it offers no marked advantage. In general it may be said that the right hand should be used for incision or dissection with knife and scissors and such other work as requires delicacy of touch. Accordingly, the right hand should be spared such heavy and tiring work as manual lysis of adhesions or work involving continued or excessive strain. If either hand must be tired by hard or protracted muscular strain, it should be the left one. A general rule may be laid down that the right hand is used where precision work is demanded and the left hand for exploration, traction, and transportation of instruments.

4. *Motions should be performed in orderly sequence to permit smooth and automatic technic.* Each phase of work should be carried on so that one step follows another in logical and unvaried succession. As each step is completed the next one should be ready to begin without delay or hesitation. When circumstances demand caution motions must of necessity be slowed down. This should be distinguished from hesitation which, when often repeated, should be investigated as to its cause. It may be due to some special characteristic of the surgeon, to faulty choice of tools or to the method of approach.

Observation of a large number of practicing surgeons indicates a prevalent use of non-essential motions due to failure to carry on a continuous line of motion. One such study showed a total of fifty-five unnecessary motions in a five-minute period by a surgeon and his assistant. A common failing when dealing with a bilateral lesion is repeated shifting of the point of attack from side to side. Careful inspection and planning would reduce the number of such shifts without increased risk or loss of efficiency. Each proposed change must be analyzed in the light of past experience and with an unprejudiced mind. It is not proposed to regiment technic but to eliminate steps based solely on preformed individual habits.

5. *Free swinging motions are faster, easier and less tiring than restricted or controlled motions.* This applies chiefly to the making of incisions. Surgical incisions vary widely but should always be planned to provide adequate exposure of the field. A rule of proved value is that an incision should be as long as is required by the individual operator and no longer.

A free swinging motion results from the use of a muscle group with no antagonist group opposing it. Such motion is seen in the swing of a golf club or tennis racket. Most primary incisions should be of this type and should be made with a continuous single sweep through the skin and subcutaneous tissue at exact right angles to the skin surface. It must be made with detailed knowledge of underlying structures and an appreciation of tissue resist-

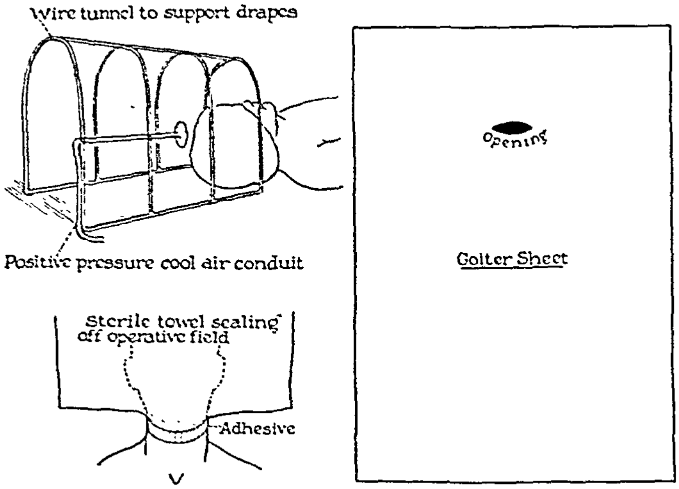
Wire tunnel to support drapes
Positive pressure cool air conduit
Sterile towel sealing off operative field
Adhesive
V
Opening
Goiter Sheet

Fig. 3. Former method of draping for thyroidectomy included (1) wire tunnel to support drapes, (2) cool air device for use with local anesthesia; (3) sterile towel fastened with adhesive below the chin and thrown upward across distal end of wire frame, (4) laparotomy sheet with acentric opening. This arrangement was effective but complicated.

ance. Unless meticulously accurate, it may be very dangerous. A long incision which does not penetrate all layers of the skin or a series of short hacking cuts marks the operator as inexperienced, fearful, or uncertain of his landmarks. Contrariwise, an overbold slashing incision is hazardous. An incision penetrating the skin obliquely makes for poor approximation and faulty wound healing.

Controlled or fixation movements produced by antagonistic muscle actions are slower and more tiring than those which work against no antagonists. Such motions come into play in threading a needle. They are delicate and precise and should be used when working in the vicinity of blood vessels or other important structures. Constrained motions, where muscles must be held rigid for guidance, should be entirely eliminated.

6. *Use the fewest motions which will do the work in the best way.* A continuous line of motion in acquiring and disposing of instruments is preferable to a series of interrupted motions since the single sweep is quicker and more certain. Similarly a continuous arc motion is easier and quicker than a straight line motion which involves sudden and sharp changes in direction. The work should be so arranged that the paths described are smooth and continuous whenever possible. However, where such a continuous motion necessitates twisting the body or crossing the arms beyond the normal range, the advantage of a single motion is nullified. In that circumstance instruments should be transferred from hand to hand. Thus, an instrument far out in the left arc area should be picked up with the left hand and transferred to the right for use.

In operative procedure, too, superfluous motions can be omitted. A thyroidectomy collar incision may require repeated ligations of the same vessel at different levels if the primary incision fails to carry through all layers and the flaps are not properly delineated before ligation of vessels is begun.

In these times of shortages it is well to check up on the use of essential materials such as linens, sponges and suture materials. Preoperative skin preparation can be made uniform for an entire service as can be the method of draping the field. The function of draping is to maintain a sterile surface and any additional use of sterile linens is pure waste. The method of draping is less important than that the same method be used by an entire service. (Figs. 3 and 4.)

Materials such as sponges, pads and sutures should be reduced to the smallest variety that will adequately serve the purpose. It is amazing what a survey will reveal in the way of unnecessarily varied dressings. Simpler or cheaper substitutes are often equally useful. It is perfectly feasible to use only large strip dressings fastened with tape and metal ring in any operation in which a cavity of the body is opened. Loose and stick sponges are not needed in such operations, as practice with strip sponges make their use entirely satisfactory and reduces the work and nerve strain incident to making small sponge counts.

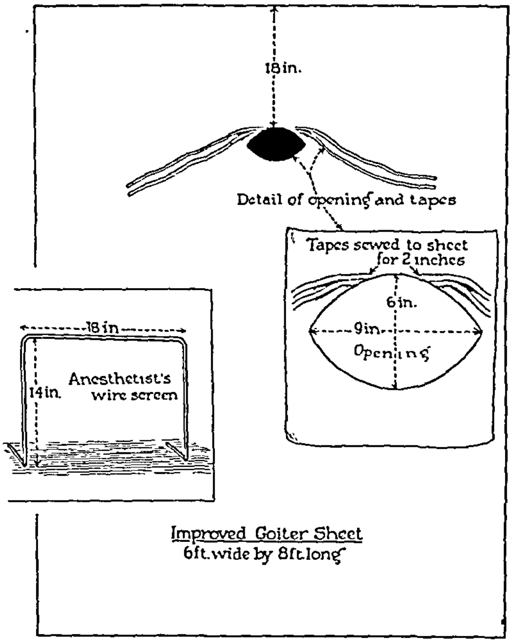
18 in.
Detail of opening and tapes
Tapes sewed to sheet for 2 inches
6 in.
9 in.
Opening
18 in
14 in.
Anesthetist's wire screen
Improved Goiter Sheet
6 ft. wide by 8 ft. long

Fig. 4. Present method of draping for thyroidectomy; modified laparotomy sheet with tapes sewed to upper level of elliptical opening. These tapes are tied behind the neck. Two pairs of tapes are more satisfactory than one.

Every operating room supervisor can testify to the amount of wasted catgut remaining after an operation. Most of this waste follows its use in ligation.

Ligatures may be limited to four types: (1) Two-handed square knot with free ends; (2) two-handed square knot with needle attached; (3) one-handed square knot, and (4) pedicle knot for mass ligation. A one-handed free tie uses roughly twice as much material as a two-handed tie. Continuous sutures use less material than do interrupted sutures but offer other disadvantages. Continuous catgut sutures should not be used when non-absorbable material is used in the same wound. They offer less security in the presence of wound infection and impose the risk of spontaneous untying of a knot which might release the entire suture layer. Economy of suture material, however desirable, must remain secondary to the safety factor. Figure-of-eight non-absorbable retention sutures may be placed so that a small coaptation loop includes only the edges of the fascia and the free ends include all layers from skin down to muscle. These provide good wound support, obliterate dead space and reduce the number of interrupted fascial sutures by one-half.

Gilbreth noted in his early studies that each craftsman, left to his own devices, used his own particular method in doing his work and no two men did their work in exactly the same way. It is advisable in addition to standardize motion procedure so that a fixed type of operation can be used in every case in which variations from predetermined technic is not indicated. Failure to adopt and carry out a repetitive technic in any one kind of operation may mean that no outstanding method has been developed or may indicate lack of thorough organization of a surgical group.

Repetitive processes properly carried out soon become automatic. A recent report on changes necessitated by a shortage of male workers in a technical industrial plant shows that where men are replaced by women precision work is done better and with more dexterity, provided that they are so placed that all tools are within reach and that the women do not have to leave fixed positions. If they are obliged to move about to complete the process, their efficiency falls rapidly to a level below that of the men. In the latter circumstance the benefits of automatic action are lost.

Fixed types of operation can be applied to large groups of cases. These should be specified and carried out uniformly by the entire surgical service and variations or additions should be considered and discussed by the group before being introduced by an individual member. This permits deliberate and reasoned consideration of new ideas, without hasty acceptance of untested changes. It is notable that a young intern's enthusiasm for each suggested change in technic contrasts vividly with the older surgeon's reluctance to leave the channels into which experience has grooved his thinking.

Some institutions and organizations have adopted standardized forms of operative procedure with marked improvement in end result. Care must be taken to avoid overdoing limitation in the choice of method, so as not to try to include cases in which variations of technic would actually be of benefit. When, however, an individual operator finds it necessary to change the accepted standard operation in more than the average percentage of cases, as determined statistically, he should be suspected of unnecessary individualism.

A scientific fact finding survey is a necessary preliminary to the institution of changes in an existing system. First, the present situation in the operating room should be analyzed and recorded. The physical set-up should be surveyed with a view to addition, elimination or rearrangement of equipment, based solely on actual requirements. The need is for the right tools located where they can do the most efficient work with the least effort. The arrangement must provide for ready acquisition, use and disposal of instruments.

1. Are the general working conditions as good as possible?

2. Is there any unnecessary moving about or back-tracking by the operating room assistants?

3. Are the instruments located and arranged to the best advantage?

4. Is provision made for the maintenance of a clean and orderly table throughout the operation?

5. Is provision made for the safe disposal and accurate accounting of needles, sponges and materials which might be left in the body?

6. Is a uniformly repetitive technic followed as far as possible?

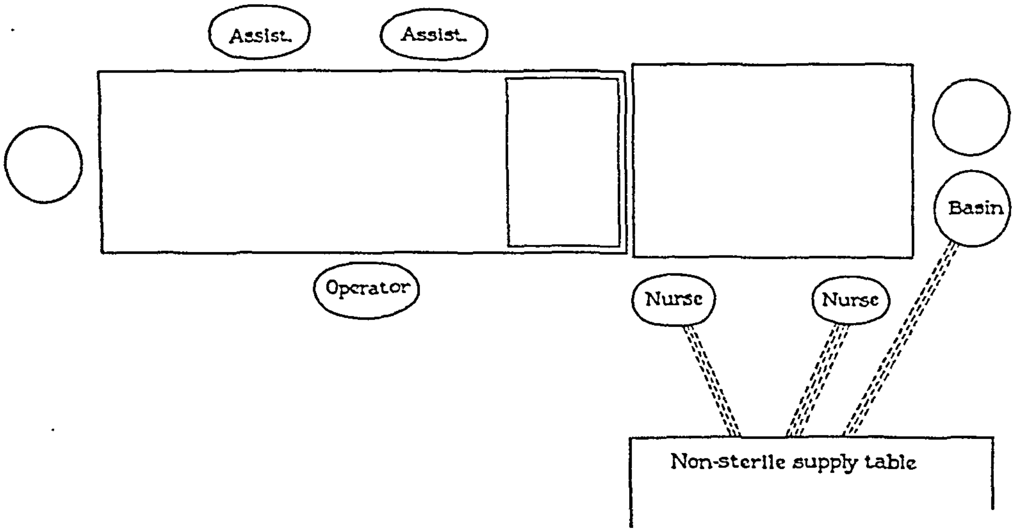

Fig. 5. Schematic outline provides a method of recording walking motions in the operating room. Each trip is marked with a dotted line indicating the path taken. Under perfect conditions there should be no marks on the chart from the time of incision until closure is completed. A separate chart should record walking motions during the period of surgical preparation. Walking paths of non-sterile personnel are best indicated in color.

7. Are motion processes smooth and continuous and in proper order?

8. Can any motions be eliminated or combined?

9. Is either hand overworked or underworked?

10. Is work properly distributed between operator and assistant?

11. Is every precaution taken to prevent fatigue?

12. Can any step be harmonized with an equally effective method used by other members of the service?

Next, consider elements of silence and orderliness. Avoid clutter by getting rid of unneeded equipment. A disorderly workplace is only too often associated with unclear thinking.

Then review existing methods of motion procedure, seeking to refine current practice, correct improperly performed functions, combine duplications, eliminate unnecessary steps and avoid unwarranted variations. Consider each step as to its necessity and desirability and subject every process to critical inspection to determine whether a good method can be replaced by a better one. (Fig. 5.)

After this weigh the human element. Decide whether the members of an operating team are working as a unit and whether the motions of individuals are carried out in proper sequence.

To justify change there must be an improved result or a result equally good with a saving of time, effort or cost. In evaluating a change immediate result must be distinguished from long range result. Installation of an improved and more effective method may actually slow down the process until sufficient time has elapsed for new methods to become automatic.

It is essential not only to find the most effective methods but to train others with sufficient thoroughness to carry on the work. Training may begin with such elementals as tying of knots, insertion of sutures and handling of instruments. A simple way to increase the agility of the left hand is to have beginners use the left hand in brushing their teeth and hair.

Hospital records indicate that the most commonly performed operations are, in order, appendectomy, repair of hernia, thyroidectomy and cholecystectomy. Appendectomy can, in a great majority of cases, be carried out under predetermined standardized technic thus becoming a repetitive process which may readily be used for the training of a new operating team or re-education of existing personnel.

A standard method of skin preparation, positioning and draping should be adopted. Distribution of duties between operator and assistants should be defined and assistants taught to use each hand to best advantage and to distribute the work load between the hands. Much can be accomplished even with rapidly changing personnel in reducing time and effort in routine surgical procedure.

The day of the natural born surgeon passed long ago and the recent years of transition have resulted in the development of three types of surgeons: old timers who learned by clinical experience sometimes supplemented by a post-graduate course abroad; the modern scientifically trained man who followed a progressive course through internship, residency, and university teaching hospital affiliation; and a group between the two who had modern medical training but, because of lack of opportunity for residencies and teaching affiliations, continued their work in self-education and development through clinical practice and study. Competence may be found in each of the three groups but it is safe to forecast that surgeons of the future will come almost exclusively from the second group. It behooves us, therefore, to train with utmost caution and infinite care the young medical graduates who come under our supervision in the plastic stage of development. Proper training should begin the first day a young intern begins his training in operative surgery, and it is important that they not be permitted to practice methods which must later be unlearned.

CONCLUSIONS

This study is concerned less with time than with motion simplification, with process rather than product control. It seeks to provide uniform, standardized equipment, placed in proper sequence within normal reaching range and in fixed and unvaried position.

Motion processes should be correctly distributed between operator and assistant and the work load divided between the right and left hands according to the special capacities of each. Motions should be smooth, continuous and decisive and as nearly automatic as possible.

Delay and fatigue factors should be identified and reduced or eliminated.

In revising current methods it is desirable to make the fewest possible changes in equipment, to use the smallest number of specialized instruments and to avoid frequent and radical changes in design or method.

Equipment and instruments already owned should be used as far as possible and in such a way as to effect the desired result by the most direct and simplest means.

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A NEW TECHNIC FOR INSTILLING AMNIOTIC FLUID CONCENTRATE INTRA-ABDOMINALLY AT THE CLOSE OF OPERATIONS

TWENTY-SEVEN CASE REPORTS

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ONE of the chief functions of amniotic fluid in its natural location is to prevent adhesions between the amniotic sac and the fetus. In 1927, Johnson[1] offered the opinion that amniotic fluid is the logical substance to prevent peritoneal adhesions following abdominal operations. The instillation of this fluid into the abdomen was suggested to Johnson following a cesarean operation in which amniotic fluid from the uterus had been permitted to spill over into the abdomen. The postoperative results in this case were unexpectedly satisfactory and consequently experiments[2] were undertaken in which concentrated bovine amniotic fluid was introduced into the peritoneal cavities of guineapigs, after the peritoneum had been traumatized. Control pigs which had not been treated with amniotic fluid developed many more peritoneal adhesions than the treated animals. Thereafter, concentrated bovine amniotic fluid was employed clinically in a number of cases.[3] The conclusions arrived at were that amniotic fluid may be used with safety in the animal or human peritoneal cavity, that it reduces the number and extent of adhesions formed, and that it does not interfere with normal healing. It was assumed that the fluid acts by reducing the amount of oozing from injured surfaces, thereby lessening the quantity of fibrin formed, and that, in all probability, it lubricates the peritoneum until the danger of adhesions has passed.

Trusler[4] subjected the peritoneum of dogs to trauma and bacterial contamination, and observed that there occurred a lower death rate in animals treated with amniotic fluid concentrate than in untreated controls. He arrived at the conclusion that amniotic fluid stimulates the normal processes of repair and thus minimizes postoperative adhesions. On the other hand, amniotic fluid concentrate is unable to digest or dissolve adhesions already formed, or to impede in any way the normal "walling off" of inflammatory areas in the peritoneum. Patients subjected to various types of abdominal operations tended to enjoy a smooth postoperative course when amniotic fluid had been used.

At a later date, Kimpton[5] reported that he had used amniotic fluid concentrate in 400 major operations. He described one particularly interesting case: The first operation on this patient had been cholecystectomy with lysis of adhesions; but dense adhesions had formed again, causing pyloric obstruction and making another operation necessary. Several subsequent operations for lysis of adhesions had followed and during the last one of these, amniotic fluid concentrate was injected into the peritoneal cavity. The immediate and remote postoperative results of this final operation were highly satisfactory. Sixteen months later the patient showed "no symptoms that would even remotely suggest the re-formation of adhesions."

My own experience with amniotic fluid concentrate began in 1931, when I used it in an operation for ventral hernia. It is my desire to describe here in chronological order twenty-seven abdominal operations performed between 1931 and 1940, in which amniotic fluid concentrate was used. I will also attempt to trace the gradual development of instruments and a more efficient technic for the introduction of amniotic fluid* concentrate into the abdomen.

CASE REPORTS

CASE I. On October 26, 1931, a female, age forty-four, had a herniotomy and lipectomy performed. An appendectomy in 1928 had been the cause of a ventral hernia, and in 1931 repair was attempted. At the close of the operation, about 200 cc. of amniotic fluid concentrate were poured through a funnel and catheter into the peritoneal cavity, but some of it spilled out on the wound surface through lacerations in the peritoneum and fascia. Serous drainage of the wound for several days following operation resulted, but the patient left the hospital improved. Subsequently, she underwent treatment for tabes dorsalis.

CASE II. On August 20, 1932, a female, age thirty-two, had a supravaginal hysterectomy and removal of postoperative adhesions performed; 200 cc. of amniotic fluid concentrate were instilled by funnel and catheter. Here, as in Case I, the consequences of a previous operation did not allow a complete subperitoneal distribution of the fluid, and a certain amount of it came in contact with the surface to be sutured for closure. Considerable postoperative serous drainage was observed, in spite of the fact that all tissue which had been in contact with amniotic fluid concentrate had been removed surgically; but the patient did not complain of abdominal discomfort. She is in good health today.

CASE III. On August 29, 1932, a female, age thirty-seven, underwent a right oophorectomy, salpingectomy, and supravaginal hysterectomy with severing of many intestinal adhesions; 400 cc. of amniotic fluid concentrate were instilled by funnel and catheter; but, in spite of careful closure, serous drainage from the bottom of the wound continued for a considerable length of time after the patient had left the hospital. There have been no postoperative abdominal complaints.

CASE IV. On September 29, 1932, a female, age twenty-one, had adhesions on the right edge of the omentum, the site of a previous appendectomy, removed. A band of omentum, reaching to the right Fallopian tube and horn of the uterus, closed the ileocecal junction; 400 cc. of amniotic fluid concentrate were instilled by funnel and catheter, and, due to the redundant peritoneum, the entire quantity entered the abdomen without any of it being lost. There followed speedy healing per primam and a short period of convalescence. She is in good health today.

CASE V. On October 6, 1932, a female, age forty-eight, had a Doyen panhysterectomy performed. The significant past history of this patient was that she had been delivered of six children at home on a farm, and without adequate medical care. The symptoms she presented were: bleeding from the vagina, badly inflamed cervix, weakness, anemia and foul-smelling vaginal discharge. Preoperative treatment included three days of continuous vaginal irrigation with a Gray reflow irrigating speculum, using a 1:2000 titanium iodide solution with a Baxter jar as container. At operation cystic ovaries, enlarged fibrous uterus, and bleeding polypi uteri were found. The cervix was enlarged, with enlarged irregular and ulcerated lips. After panhysterectomy, 400 cc. of amniotic fluid concentrate were instilled. Because of redundant peritoneum the entire quantity was easily introduced subperitoneally by the catheter-and-funnel method. Recovery was uneventful. The choice of amniotic fluid concentrate with primary closure was considered preferable to vaginal drainage, a decision justified by the results. The patient is well to date.

CASE VI. On April 14, 1934, a female, age fifty-four, presented partial intestinal obstruction, massive abdominal adhesions and a ventral hernia. The patient had undergone an operation for gangrenous appendicitis twenty-eight years previously. There were adhesions between many abdominal organs, namely, liver, stomach, small intestine, colon, uterus and adnexia. Following operation, which included separation of tough adhesive bands, 400 cc. of amniotic fluid concentrate were instilled. (But this procedure was not accomplished as easily and successfully as desired, and it became apparent that a new technic for the instillation of amniotic fluid concentrate was required.) The patient responded well and improved. Her death after three years was due to cardiac decompensation and had no connection with this operation.

CASE VII. On April 24, 1934, a female, age thirty-four, had a right oophorectomy, supravaginal hysterectomy (endometriosis), removal of adhesions and lipectomy performed. Previous operations had been: appendectomy and removal of tumor of left ovary with both tubes in 1920, followed by bilateral inguinal herniotomy in 1932. An attempt to instill 400 cc. of amniotic fluid concentrate intra-abdominally, by means of catheter and funnel, did not succeed. After approximately one ounce had been introduced in this manner, it became obvious that the fluid escaped into adjacent muscle and fat tissues. Therefore, the remaining 370 cc. had to be instilled by means of a 50 cc. syringe with a No. 19 gauge needle inserted into the right lateral side of the abdomen. In this instance, positive pressure was substituted for gravity, in order to force a sufficient amount of amniotic fluid concentrate into the peritoneal cavity. The patient recovered rapidly in spite of some serous drainage, and suffered no more abdominal complaints. In 1938, she was confined to a sanatarium because of mental deterioration, where she died of chronic alcoholism of long standing.

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* The amniotic fluid concentrate used in all of these cases was "Amfetin" (Amniotic Fluid Concentrate, Lilly).

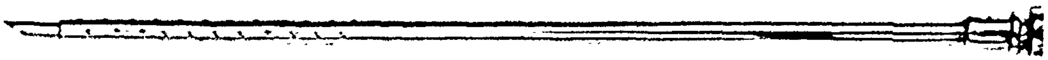
Fig. 1. Photograph of trocar with stylet.

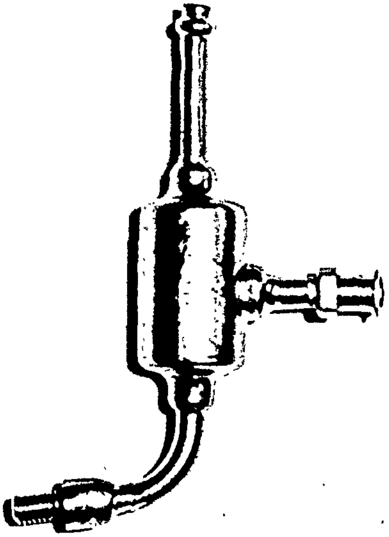
Fig. 2. Photograph of two-way valve.

Case viii. On November 5, 1935, a male, age thirty-nine, presented a case of chronic appendicitis with adhesions. In this case, only 200 cc. of amniotic fluid concentrate could be instilled via funnel and catheter, and it was necessary to discard about 100 cc. of the fluid. The patient improved steadily. Freed from toxic symptoms including a disabling sciatica, he has since been able to practice his profession profitably. At present he is under treatment for a Giardia infection.

The foregoing experiences with the funnel-and-catheter method led to the conclusion that a special instrument for the introduction of amniotic fluid concentrate into the peritoneal cavity was required. A dull-edged trocar was designed and made (Fig. 1), about 24.4 cm. in length and approximately 0.5 cm. in diameter. A stylet with a relatively dull edge was made to fit the bore of the trocar. A series of small openings, arranged in four columns, extend from the distal end up the shaft of the trocar, about 7.5 cm. The length of the trocar allows the surgeon to project the distal end beyond the midline by means of a small abdominal incision. By directing the trocar toward the opposite pelvic rim, he avoids any undue pressure upon the incision line while the fluid is being administered. (Fig. 1.)

The proximal end of the trocar is covered with threads which are the recipients of threads on a two-way valve. (Fig. 2.) Thus, the trocar and two-way valve can be joined securely together.

To one of the remaining two openings of the two-way valve is fixed an arrangement permitting the use of a 100 cc. syringe (Luer-Lok preferred), while the remaining opening is attached to the end of a small-caliber rubber tubing, which by means of a glass adapter tube is connected to a rubber tube of sufficiently large caliber to fit over the end of the Kelly jar. This system permits the sucking of amniotic fluid concentrate from the Kelly jar into the valve, thence into the syringe. By positive pressure the amniotic fluid concentrate is then instilled into the abdomen at will. (Fig. 3.)

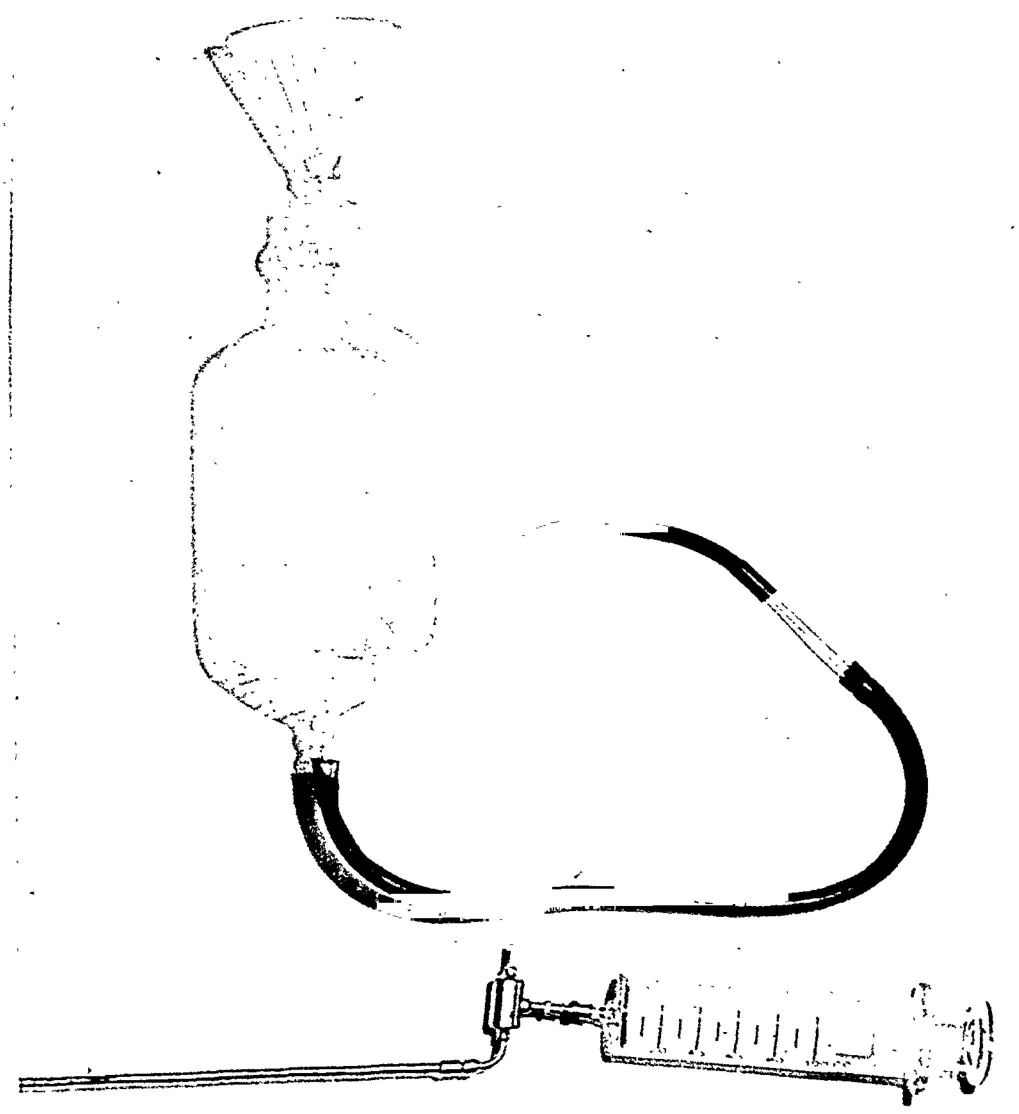

Fig. 3. Photograph of complete apparatus.

In this manner the maximal amount of amniotic fluid concentrate may be instilled into the peritoneal cavity. At the same time, the process can be stopped immediately at the point where further instillation would lead to spilling of the fluid outside of the peritoneum.

It may be said that the careless handling of tissues, and especially insufficient care at closure of the abdominal wound is a common cause of adhesions, frequently forcing the patient to seek surgical relief through a subsequent operation. Amniotic fluid concentrate, properly administered, plus a systematic method of closure seems to offer a satisfactory means of overcoming these difficulties.

In all cases, unless otherwise indicated, the incision was kept in or near the midline. Thus the cutting of muscles is avoided. The cutting of fascia is preferable to the cutting of muscles by reason of the better healing qualities of fascia. The closure was made according to the teachings of Edward H. Ochsner, who maintains that the peritoneum should be closed from both ends of the wound toward the middle of the longitudinal incision axis. By this method a better closure can be expected, and injury to the bowel or other abdominal tissue in the final process of closing the abdominal cavity becomes unlikely. It also decreases the danger of the end of the suture pulling out, causing a hernia.

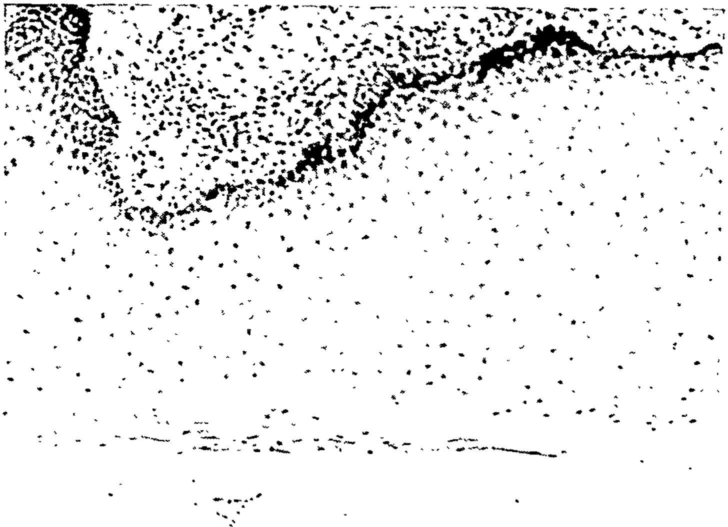

Fig. 4. Case v. Photograph of squamous epithelium of cervix uteri.

Using double No. 1 plain catgut, the peritoneum is sutured from both ends toward the middle, until the operator is able to insert no more than two fingers of the left hand, which function as a guide from within, against the lateral wall of the lower part of the abdomen. With the right hand a sharp scalpel is used to make a small hole through the abdominal wall and barely through the peritoneum. Then, still keeping the fingers of the left hand in place, the dull-edged trocar with its dull stylet is inserted into the abdomen through the small wound. As soon as the trocar enters the abdominal cavity, the stylet is immediately withdrawn and a sterile towel placed over the exposed end of the trocar. The distal end, being dull and having no undue pressure exerted upon it, rests freely and harmlessly in the abdomen. The peritoneum is then closed. The several tension sutures used, serve: (1) in order to relieve the strain on the longitudinal suture line, and (2) to lessen the accumulation of exudate, blood, etc., in pockets between fascia and muscles.

The fascia sheaths or fascia are then closed by double No. 1 chromic catgut. Sometimes a few interrupted plain sutures are placed loosely in the muscle following which a warm sponge is placed in the wound. Next, one part of the two-way valve (described previously) is attached (1) to the outer end of the trocar, (2) the second one to a 100 cc. syringe, and (3) the third outlet is fastened to the rubber tubing from the Kelly jar. The amniotic fluid concentrate is then instilled into the peritoneal cavity as desired. As soon as this is accomplished, the trocar is removed and the small wound through which it was inserted is sutured. Six strands of silkworm gut sutures are placed at the bottom of the wound with their distal ends projecting below the end of the skin wound to act, for a few days, as a subcutaneous drain. The skin is closed with sutures or clips.

In the case reports which follow, the method just described has been used for the administration of 200 to 800 cc. of amniotic fluid concentrate.

Case ix. On December 6, 1935, a female, age thirty-nine, underwent an appendectomy, right salpingo-oophorectomy and removal of adhesions. This patient had suffered a Neisserian infection eighteen years previously. Amniotic fluid concentrate, 200 cc., was successfully instilled by means of the trocar. The wound healed per primam. The patient recovered steadily and has remained in good health.

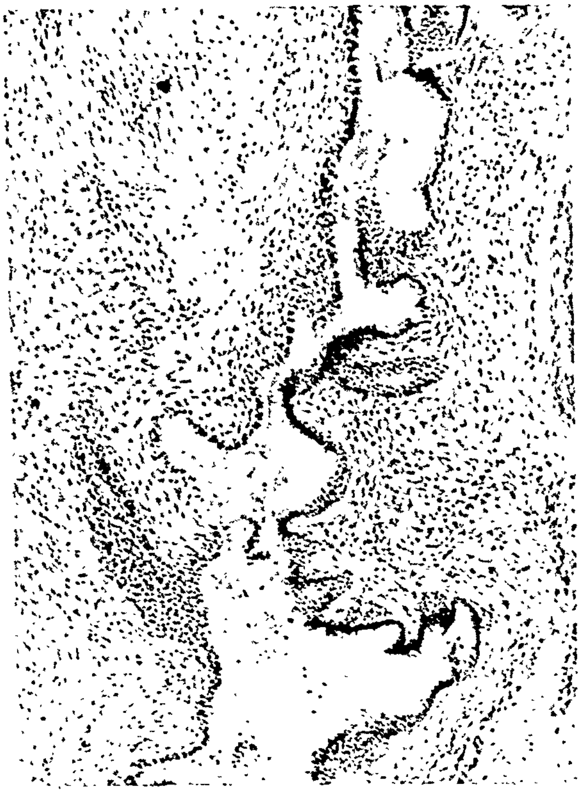

Fig. 5. Case v. Photograph of glandular hypertrophy of cervix uteri.

Case x. On May 12, 1936, a female, age fifty-six, had a panhysterectomy performed. The patient complained of a tired feeling and of bleeding at irregular intervals, for three months. A foul vaginal discharge was present and an ulcer was found on the posterior cervical lip of the uterus. Radium treatment was refused by patient and family. For three days previous to operation a daily vaginal irrigation was carried out with titanium iodide solution 1:2000 through a Gray reflow vaginal speculum and Baxter type jar container. After panhysterectomy, 400 cc. of amniotic fluid concentrate were easily instilled by trocar. The cervix lesion was a squamous cell epithelioma. The patient improved after surgery and returned home maintaining the improvement for some time. Death due to carcinoma of the intestines occurred ten months after operation.

Case xi. On July 16, 1937, a female, age twenty-one, underwent an appendectomy and removal of adhesions. Amniotic fluid concentrate, 200 cc., was easily introduced by trocar. Healing occurred per primam. There have been no abdominal complaints to date. The only medical attention sought since operation was for the uneventful normal delivery of a baby.

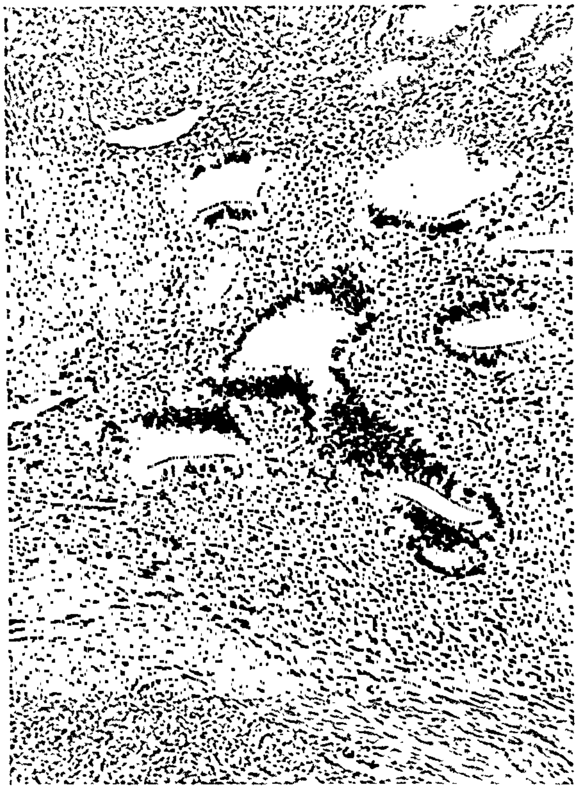

Fig. 6. Case vii. Photograph of endometriosis of uterine wall. From a 2 cm. nodule of posterior wall of uterus 4 by 4 cm. (Measurements of pathologist, Dr. J. W. Budd.)

Case xii. On August 6, 1937, a female, age twenty-six, had a left salpingo-oophorectomy performed. The patient had undergone appendectomy five years previously. A left parovarian cyst and salpingitis were found, complicated by adhesions from the previous operation. Amniotic fluid concentrate, 200 cc., was introduced by trocar. The patient made a rapid recovery and is at present in a good state of health.

Case xiii. On September 9, 1937, a female, age thirty-eight, underwent an appendectomy, removal of adhesions and freeing of a Jackson membrane. The adhesions appeared to be the result of some previous peritoneal inflammation. Amniotic fluid concentrate, 200 cc., was instilled via trocar. The patient improved, except for a Staphylococcus albus infection at the lower end of wound. This responded to treatment with a Staphylococcus albus lysate. She is in good health at present.

CASE XIV. On December 1, 1937, a female, age twenty-seven, underwent an appendectomy, right salpingo-oophorectomy and removal of adhesions. Amniotic fluid concentrate, 400 cc., via trocar was instilled. She had an uneventful recovery and is now in a good state of health.

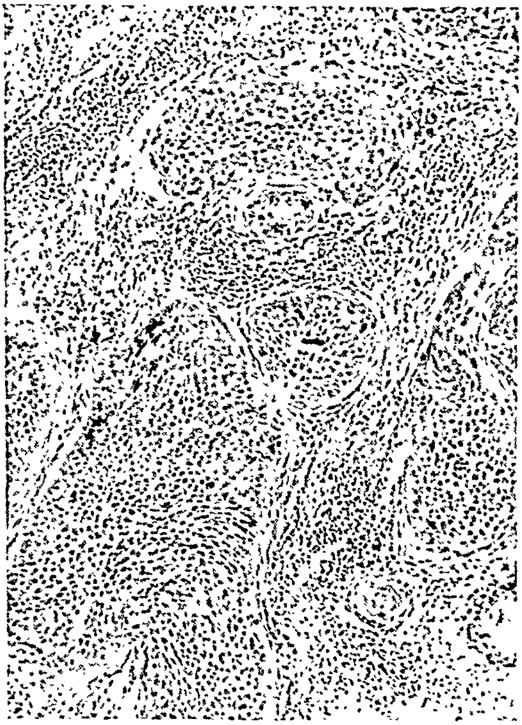

FIG. 7. Case X. Photograph of squamous cell carcinoma of cervix uteri. Grade III. (Opinion of pathologist, Dr. Maner.)

CASE XV. On December 31, 1937, a female, age fifty-two, underwent a cholecystectomy and removal of adhesions. This patient's past surgery included: appendectomy in 1907, left breast removed in 1932, right breast removed in 1936 (Schimmelbusch's disease). Amniotic fluid concentrate, 600 cc., was instilled via trocar, and the wound closed without drainage. The patient recovered and is in good condition today. However, because of the possibility of accessory biliary sinuses, etc., Walters'[6] advice that a drain should be employed as a matter of routine for about seven days, appears to be highly justified.

CASE XVI. On April 21, 1938, a female, age thirty-four. Bilateral oophorectomy, appendectomy and removal of bilateral peritoneal adhesions were performed. Amniotic fluid concentrate, 600 cc., was instilled by trocar. The wound healed per primam and recovery was uneventful and rapid. The patient's health is good to date.

CASE XVII. On June 29, 1938, a female, age fifty-six, was operated upon for appendicitis and removal of right tube and ovarian cyst. Amniotic fluid concentrate, 400 cc. was introduced by trocar. The wound healed per primam and her condition is much improved. She is successfully carrying on her profession.

CASE XVIII. On July 28, 1938, a female, age twenty-four, had an appendectomy performed. Amniotic fluid concentrate, 200 cc. was instilled by trocar. The wound healed per primam and she had an uneventful recovery. The patient is in a good state of health to date.

CASE XIX. On March 30, 1940, a female, age fifty, had an appendectomy performed and freeing of many dense adhesions from a previous pelvic peritonitis; 400 cc. of amniotic fluid concentrate were instilled via trocar. The patient had a nutritional deficiency of long standing, resulting from neurosis. On the tenth day the patient suffered an evisceration, and a second operation had to be performed on April 9, 1940. A Judd type catheter was inserted in the ileum; this was accidentally pulled out of the intestine, while a nurse was arranging the gauze dressing. A Miller-Abbott tube was introduced. Blood transfusions were given April 10th, 15th and 26th. In view of the deficient healing of the tissue, large doses of vitamin C and the best available B complex compounds, calcium, parathyroid extract, etc., were administered. The use of the Miller-Abbott tube was followed by a parotitis on the right side. The infecting organism proved to be Staphylococcus aureus. The parotitis responded favorably to treatment with Staphylococcus aureus lysate. In spite of the trauma and fecal contamination, incident to the evisceration and its repair, the patient did not develop peritonitis and its lethal sequelae. It may safely be assumed that absence of peritonitis in this case can be attributed to the use of amniotic fluid concentrate at the time of the first operation. The abdominal wound healed well and the patient was released from the hospital in good condition. She improved steadily upon a strictly supervised diet, etc. Her health at present is good.

CASE XX. On April 4, 1940, a female, age thirty-four, had an appendectomy performed and freeing of adhesions. Amniotic fluid concentrate, 800 cc. was instilled via trocar. The wound healed promptly and the patient improved rapidly. Her health is very good at present.

Fig. 8. Case xii. Photograph of papilloma on wall of parovarian cyst.

Case xxi. On May 1, 1940, a female, age thirty-two, had a right salpingectomy and removal of the right parovarian cyst performed. Amniotic fluid concentrate, 800 cc., was installed via trocar. The wound healed per primam and the patient's condition is good today, except for moderate obesity.

Case xxii. On May 23, 1940, a female, age twenty-seven, suffered from bilateral salpingitis, pelvic peritonitis with serosanguineous exudate, visceroptosis, chronic appendicitis, enlarged liver and subacute ileitis. The latter was apparent from preoperative *x*-ray examination. Appendectomy was performed and amniotic fluid concentrate, 600 cc., administered intra-abdominally, in view of the peritonitis. The wound healed per primam. The patient was kept in bed for a short time postoperatively and given a smooth diet, high in vitamins and calories. She was later referred to Dr. Jellen for a postoperative *x*-ray film series, and his reports as well as others to date give no indication of abnormality. Amniotic fluid concentrate as a treatment for peritonitis appears to have been of great value in this case.

Case xxiii. On June 19, 1940, a female, age thirty-two, had an appendectomy and removal of adhesions performed. Amniotic fluid concentrate, 800 cc., was instilled by trocar. She had a rapid uneventful recovery. The wound healed promptly per primam. The patient is active and in excellent health to date.

Case xxiv. On July 5, 1940, a female, age forty-four, suffered from chronic alcoholism which had caused a definite nutritional deficiency. Appendectomy and freeing of adhesions were performed. Amniotic fluid concentrate, 800 cc., was instilled by trocar. The patient made a rapid, uneventful convalescence. Postoperative liver function test showed vast improvement over that taken preoperatively. Her general health improved, except for moderate obesity.

Case xxv. On July 16, 1940, a female, age fifty, underwent the removal of an enormous hydrosalpinx wedged deeply into the pelvis, with dense adhesions, between all possible adjacent tissues. Previously, in Chicago, the patient had been given *x*-ray treatment for an abdominal tumor. Amniotic fluid concentrate, 800 cc., was instilled by trocar. A subcutaneous infection developed at the lower end of wound, but the inflammation responded promptly to Staphylococcus aureus lysate. The patient recovered promptly and was restored to full health on the twenty-seventh day after operation. In view of the widespread trauma suffered by pelvic and abdominal tissues, this result was particularly pleasing. She is in excellent health to date.

Case xxvi. On July 17, 1940, a female, age thirty-nine, underwent a right salpingectomy, oophorectomy, removal of adhesions and appendectomy. Amniotic fluid concentrate, 800 cc., was instilled via trocar. The patient recovered promptly and was in a very good state of health a few weeks later. A great amount of trauma was caused to the pelvic and abdominal tissues, and it stands to reason that amniotic fluid concentrate must have been of great value, in view of the favorable response of the patient. She is in very good health to date.

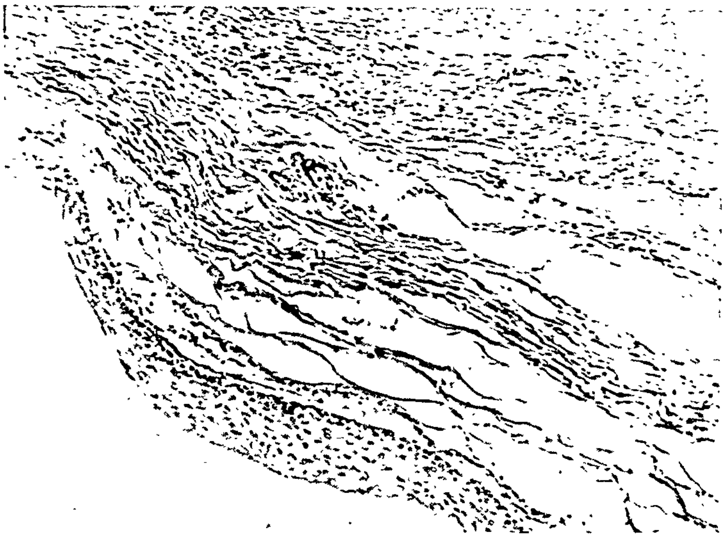

FIG. 9. Case XXVII. Photograph of squamous cell lining of ovarian dermoid cyst.

CASE XXVII. On July 26, 1940, a female, age twenty-seven, had a right oophorectomy (*dermoid cyst*) and appendectomy performed. Amniotic fluid concentrate, 800 cc., was instilled via trocar. She had a rapid recovery and is in excellent physical condition to date.

COMMENTS

A comparison of the results of the first eight cases with those of Cases IX to XXVII indicates that instillation of amniotic fluid concentrate by means of the trocar plus positive pressure is definitely superior to the funnel method previously used. Peritoneal sacs vary as much as the faces of different individuals. One patient may have a well developed, thick peritoneum, and then again the peritoneum may be so small that there remains little space between intestine and peritoneal wall sac. In one case, positive pressure may be necessary in order to instill enough amniotic fluid concentrate. In another, as for example in Case IV, there may be a sufficiently redundant peritoneum, so that adequate amniotic fluid concentrate instillation is easily accomplished by gravity alone. But only a method of instilling amniotic fluid concentrate, which will succeed adequately under *all* conditions can be considered as entirely satisfactory. The trocar method exerting positive pressure fulfills this requirement.

Different substances have been used to assist the defense mechanism of the peritoneal cavity, in resisting the ravages of infection and the consequences of trauma. But it seems that amniotic fluid concentrate accomplishes that function best. From the point of view of physiology, the use of amniotic fluid concentrate can readily be justified. In all cases described here, it has been instilled postoperatively. There is no desire to detract from the possible usefulness of amniotic fluid concentrate preoperatively; but certain reasons exist which make its instillation at the close of the operation preferable.

When an incision is made into the peritoneum and the contents of the peritoneal cavity are, however slightly, exposed, there occurs an immediate, though perhaps imperceptible thermal and aqueous loss, causing some degree of disturbance in the normal physiology. Amniotic fluid concentrate adds a liquid substance at the very place where it was lost. It supports the intra-abdominal pressure, and to a certain extent the blood pressure. None of the patients described suffered shock following the use of amniotic fluid concentrate.

Even though there are no indications to suggest that amniotic fluid concentrate is able to dissolve adhesions which have developed previously, it prevents the formation of new ones. As new adhesions may be produced through the irritating effect of an inflammation, the preventive action of amniotic fluid concentrate may be traceable to its ability of forestalling the development of such inflammations. In this relation it is well to remember some of the properties of the human amniotic fluid. Over forty-one years ago, Bondi,[7] working in Schauta's clinic under very rigid precautions, established among the substances present in liquor amnii: pepsin, a diastatic ferment, a lipolytic ferment and a fibrin ferment. De Lee and Greenhill[8] ascribe to amniotic fluid an important bactericidal function during labor, as it washes out the vagina previous to the passage of the child, and thus acts as a preventive against infection of the child and the uterine cavity. This is not the place to enlarge on the problem of amniotic fluid concentrate in its relation to inflammation, a subject treated extensively by Rigdon and Warren.[9]

It may also be said that amniotic fluid concentrate probably exerts a mechanical influence, minimizing the effects of trauma. Meticulous care for the prevention of raw or oozing surfaces is a necessary precaution. Yet, if in spite of care such a condition should occur, the presence of amniotic fluid concentrate in the peritoneal cavity will separate the traumatized peritoneum from adjacent surfaces and at the same time stimulate the damaged surface into repair.

The experience gathered from the twenty-seven cases submitted here indicates, that the presence of amniotic fluid aids in restoring normal bowel movement. A natural movement was commonly obtained on the third day after operation. Often a movement which was soft to fluid was obtained on the second day.

In the early cases, 200 cc. of amniotic fluid concentrate were used. Later, the amount introduced whenever possible was 800 cc., and with the aid of the trocar it was frequently possible to instill the entire quantity. Various reasons led to preference of this larger volume. The area covered by the peritoneum is large. If it is true that the mechanical effect of the fluid in separating tissues exercises a beneficial influence, the instillation of the largest quantity possible must appear desirable, in order that the entire peritoneal surface may be in contact with the fluid. This large quantity supplies more fluid, more intra-abdominal pressure, and more local mechanical protection. Moreover, it has been observed that those patients who were given larger quantities recovered in shorter time and felt more comfortable during that period than those who received only 200 cc. However, it must be remembered that patients with a relatively small peritoneal cavity cannot accommodate 800 cc. and will do well on less. In Case XXII, 600 cc. were instilled. The patient suffered from ileitis and peritonitis, and it was believed that the use of amniotic fluid concentrate aided considerably in her recovery.

The cases in which amniotic fluid concentrate has been used, have shown less or no evidence of postoperative gastrointestinal symptoms (abdominal discomfort, indigestion, belching, intestinal stasis, or even constipation) compared with those not treated with amniotic fluid concentrate.

SUMMARY AND CONCLUSIONS

Twenty-seven cases of abdominal operations are described in which amniotic fluid concentrate was instilled intra-abdominally, immediately before the peritoneum was closed.

Instillation in the first eight cases was attempted by the funnel-and-catheter method, the fluid reaching the peritoneum by gravity. In the remaining cases the fluid was instilled through a specially designed trocar, positive pressure being substituted for gravity. The later method, using the trocar and positive pressure, proved preferable to the earlier one which relied on the funnel and the aid of gravity alone.

I wish to acknowledge my sincere thanks to Dr. W. G. MacCallum for his constructive criticism, Dr. Leon Jones for many helpful suggestions, and to Mr. Jim Smith for aid in photography.

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If an extensor tendor is severed, a simple yet practical method is to suture the cut ends with stainless-steel wire, the same suture being made to unite the skin as well. Adequate splinting will prevent the tendon ends from pulling apart.

From "Minor Surgery," edited by Humphry Rolleston and Alan Moncrieff (Philosophical Library).

FRACTURES OF THE FEMUR

RESULTS OF TREATMENT OF 179 PATIENTS

Howard A. Swart, M.D. and George Miyakawa, M.D.
CHARLESTON, WEST VIRGINIA

It is generally conceded that femoral fractures are the most difficult of all in which to obtain good results. We wish to present the results of treatment of 184 fractures in 179 patients. These were treated from June 1, 1935, to May 1, 1942, on the Traumatic Service of the Charleston General Hospital.

In three patients both femurs were broken and two patients were treated twice for femoral fractures. There were twenty-eight fractures of the neck of the femur, thirty-six intertrochanteric fractures, twenty-three subtrochanteric and upper third fractures, sixty-nine in the middle third of the shaft and twenty-eight in the lower third of the shaft.

FRACTURES OF THE NECK OF THE FEMUR

The average age of the patients who suffered fractures of the femoral neck was fifty-nine. There were twenty-seven fresh fractures and one in which the diagnosis was not made for one year following injury. The original *x*-rays were negative and upon reviewing them after the fracture was found, the fracture line still could not be seen.

Following the Leadbetter reduction, a Smith-Petersen nail was inserted over a Kirschner wire by the blind method in thirteen patients. The results were excellent in three; that is, the patients could walk without pain and had no stiffness. In four cases, results were classified as good, there being some stiffness or pain. There were two cases rated as fair and three as poor. Aseptic necrosis of the head of the femur resulted in two cases. In one painful ankylosis followed and in the other cup arthroplasty was done elsewhere with a fair result. One patient died twelve hours following operation, apparently from an embolus.

Prior to the advent of the Smith-Petersen nail, the Leadbetter reduction and cast was carried out in seven cases, with one excellent, four good and two poor results.

The Roger Anderson well leg splint was used in one case but the result was poor.

In one case of impacted fracture in a man of forty-five, a Kirschner wire was inserted through the lower femur, but non-union resulted and a bone grafting operation was done later with a good result.

In the one case of non-union previously mentioned, a Lorenz osteotomy was done but the fracture failed to unite.

Comment. In spite of the introduction of newer methods of treatment, fractures of the neck of the femur are still difficult to treat. Of the twenty-eight cases, five had insufficient follow-up. The results then of twenty-three cases were as follows:

	No.	Per Cent	
Excellent	4	17.4	
Good	9	39.1	
Fair	2	8.7	Acceptable 56.5%
Poor	7	30.4	
Died	1	4.4	

The use of the Smith-Petersen nail affords firm fixation, but does not guarantee union, even though the patient be kept in bed three or four months postoperatively. Aseptic necrosis and non-union still result in many cases, probably due to interference with blood supply. It is our opinion that the fate of the fracture is decided at the time of the accident. Then, either the blood supply is so seriously impaired that no treatment will produce a good result, or the blood supply survives and with intelligent treatment, union will result.

The Leadbetter method of reduction and cast treatment deserves more praise than it has received. The reduction will in practically all cases correctly align the fracture fragments as shown by anteroposterior and lateral *x*-rays, and the cast treatment will produce good results in a high percentage of cases. It is unfortunate that it was introduced just at the time the internal fixation method was brought out. Otherwise it would have received greater fame, as it is clearly superior to the Whitman reduction and cast. The Roger Anderson well leg splint and the Kirschner wire traction should never have been used in treating these patients.

INTERTROCHANTERIC FRACTURES

There were thirty-six in this group and their average age was 60.5 years. It is in this type of fracture that the Roger Anderson well leg traction splint has its great value. We used it in twenty-two patients. Seven patients had spica casts, four had supportive treatment only, because of advanced age and poor condition, and one was treated by skin traction. As an experiment, early in the series, two patients were treated by ordinary Smith-Petersen nails. In one, the result was excellent but in the other a good deal of stiffness resulted. Ten patients died while under treatment. We found that many of the old people would develop pressure ulcers and die of inanition. They never became strong enough to sit up in wheel chairs at any time following operation. The results:

	No.	Per Cent	
Excellent	10	27.7	
Good	11	30.5	
Poor	2	5.5	Acceptable 58.2%
Died	10	27.7	
Unknown	4	8	

Comment. The Roger Anderson well leg splint was found to produce good apposition of the fragments, resulting in union if the patient could be kept alive. More recently we have used the Carl P. Jones traction splint in which no skeletal traction is necessary, but the casts have to be put on one day and the traction splint the next day, after the plaster has hardened. Thus the danger of infection about the pin is avoided but the treatment prolongs the period of discomfort to the patient before the traction is actually applied. We still prefer the well leg splint in which there is much displacement of fragments, necessitating strong traction.

The recent introduction of the flanged nail with a side arm running down the shaft for treating intertrochanteric fractures necessitates open operation, but if the patient can be gotten up to walk or at least sit up soon after operation, it may be that many of the pressure ulcers and deaths from inanition can be avoided. It remains to be seen whether or not these advantages will outweigh the extra risk of open operation.

SUBTROCHANTERIC AND UPPER THIRD FRACTURES

There were twenty-three in this group and their age averaged thirty-three years. We now get into the group of younger patients with better general condition and as a result better prognosis. The Roger Anderson double pin fixation with short cast was used in one case with a poor result. Kirschner wires were used in seven patients. The results in two were excellent, in three good and in one poor; this resulted in infection. In one case the position of the fragments was so poor that open operation and plating was done with a good end result. Skin traction was used in nine cases. There were four excellent, two good and one poor result. The latter was plated with a good result. Following traction, another femur was fixed by means of a Parham band with a good result. One of the patients treated by skeletal traction died. Of two patients treated with the well leg splint, the result was good in one and one had to be operated upon and a Parham band applied, finally healing in good position. In two patients the condition was so poor that supportive treatment only could be carried out. One patient, treated simply by a spica cast received an excellent result. One non-union was plated with a good result. The results:

	No.	Per Cent	
Excellent	8	34.7	
Good	9	39.1	
Fair	1	4.3	
Poor	2	8.7	Acceptable 73.8%
Died	3	13	

Comment. As can be seen the results in this series were better than in the fractures of the neck or intertrochanteric areas, chiefly because the patients were younger. We have found considerable difficulty in holding fractures in the subtrochanteric area by skeletal traction in any form. These fractures are not common, and probably the best form of treatment is open operation with the use of vitallium plates and screws. We have had displacement to occur with one eight-hole plate in place, thus bringing up the advisability of using two plates, one on the anterior and one on the lateral surface of the femur. The leverage at this point is considerable due to the great length of femur below it.

FRACTURES OF THE MIDDLE THIRD OF THE SHAFT OF THE FEMUR

There were sixty-nine in this series, thirty-five being in children below fifteen years of age with an average age of five, and thirty-four above fifteen with an average age of thirty-four.

Under the age of six, bilateral skin traction, with the legs extended at the knees and flexed at the hips, was used in twenty-four cases, with twenty-two excellent results, one good result and one unknown. After three weeks in traction in these patients, spica casts were applied and worn six weeks.

In the adults, Kirschner wires through the lower femur were used early in the series. Of sixteen patients so treated, the results were excellent in six, good in five, fair in one and poor in three. Two of the latter were treated by open operation, a plate being applied in one and a Parham band in another. The end results in the two cases were good.

Russell traction with adhesive was carried out in eighteen cases with eight excellent results, seven good results, two fair results. The outcome of one case was undetermined.

The Roger Anderson double pin fixation was used in four cases. There was one good result, one fair result, in which infection developed around the upper pin, and two definitely poor results.

A simple spica cast was used in three cases with two excellent results and one good result.

Adhesive traction was used in three adults, with two excellent results and one good result.

In one patient no treatment except supportive could be carried out and he died of fat embolism, proved by autopsy.

The results:

	No.	Per Cent	
Excellent	40	59	
Good	20	29	
Fair	4	6	Acceptable 88%
Poor	2	3	
Died	1	1	
Unknown	2	2	

Comment. In children, the adhesive overhead, or Bryant's traction affords satisfactory results in practically every case. Even though some malposition or overriding occurs, the fracture unites quickly and any inequality is rapidly overcome.

We have proved that Russell traction is much the best form of treatment in middle third fractures in adults. The patients are more comfortable, the fragments become aligned more quickly and the knee does not become as stiff as when skeletal traction is used. The traction must be inspected frequently to keep all the angles correct; but if this is done, union results in a minimum of time and with comparatively little disability. To obviate the occasional difficulty caused by the adhesive slipping, we have recently applied the traction by means of a Kirschner wire through the heel. To keep the foot upright, however, it is necessary to apply a plaster boot, with a wood cross piece just proximal to the heel. If this is not done, the foot will evert producing pressure on the lateral side of the wire causing pain and predisposing to infection. This method has not been used in enough cases to determine whether or not in the long run it will prove superior to the adhesive method.

FRACTURES OF THE LOWER THIRD OF THE FEMUR

There are twenty-eight in this series and their ages averaged 36.6 years. It is in this type of fracture that Russell traction is not so effective due to the persistent anterior or posterior displacement of the distal fragment. At first we used a single Kirschner wire through the distal fragment for longitudinal traction. Because of persistent displacement anteriorly or posteriorly of one or both fragments, one of us (H. A. S.) devised a method whereby a second wire was placed through either the distal end of the proximal fragment or the proximal end of the distal fragment and pull was made anteriorly or posteriorly, as the case demanded.[1] Later a third wire was added so that anterior and posterior pull, as well as longitudinal pull could be made simultaneously. The two wire technic has been used in four cases and the three wire technic in four cases, all with good results. However, because the second and third wires must be introduced with the leg in traction, it is difficult to preserve complete asepsis, and infection has resulted in two cases. In one it was of the soft tissues only and quickly cleared up, but in the other chronic osteomyelitis developed necessitating sequestrectomy.

Kirschner wires were used in fifteen of the twenty-eight cases. There were six excellent results, four good results and two fair results. In one case a plate had to be applied, in another a Parham band, following failure of single wire traction. These were done before the multiple wire technic was introduced.

The Roger Anderson double pin method was used in two cases with poor results. In both the method was changed to Kirschner wires with good results.

Russell traction was used with excellent results in two cases, good results in four cases and a poor result in one case. This patient developed gangrene of the lower leg and foot due to injury to the blood supply and amputation was necessary.

One other leg was amputated because of severe maceration of soft tissues.

A long leg cast was used in one case with a very good result and a spica cast was used in two cases with excellent results in both.

The results:

	No.	Per Cent	
Excellent	8	28.6	
Good	12	42.8	
Fair	3	10.7	Acceptable 71.4%
Poor	2	7.1	
Unknown	3	10.7	

There were five compound fractures of the femur. These wounds were all carefully débrided and washed out. One in the upper third was treated by Kirschner wire traction with an excellent result. Another in the upper third was treated with a Kirschner wire, but infection developed in the wound and the subsequent use of the leg was only fair. Another patient with an upper third fracture died of shock. One lower third fracture could not be aligned by wire traction, but obtained a good result following plating after the wound had healed. The fifth, a fracture of the lower third, resulted in amputation.

CONCLUSIONS

The use of the Smith-Petersen nail is still the best method of treating fractures of the neck of the femur, although there have been many failures even when this method is efficiently used. Certain factors militate against success in treating this fracture no matter what is done.

The Roger Anderson well leg splint was used successfully in intertrochanteric fractures in patients who could be kept alive. We have had no experience with the use of Smith-Petersen nails with side arm extensions, but if following this operation patients can be made ambulatory, better results should be expected.

In treating subtrochanteric fractures, it is our opinion that open operation with the use of two vitallium plates is the method of choice.

Our results with Russell traction in the treatment of upper and middle third fractures have been so good that we are enthusiastic about the method. Union results in a comparatively short time and the degree of knee stiffness is less than when other methods are used.

Disability following fractures of the lower third of the femur is still high, but we have obtained good anatomical position of the fragments with the use of two and three wire Kirschner traction as described.

REFERENCE

1. Swart, Howard A. Treatment of fractures of the shaft of the femur by double wire traction. *Am. J. Surg.*, 52: 507–510, 1941.

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Suspect fracture of the os calcis after a fall in the standing position, even when there is no deformity of the foot. Also suspect fracture of the spine after every injury of this nature. Do not manipulate the foot for several days or even apply plaster of Paris, until the bogginess of the heel has subsided with rest and elevation in bed.

From "Fractures and Dislocations for Practitioners," by Edwin O. Geckeler (The Williams & Wilkins Company).

EFFECTS OF SULFANILAMIDE AND AZOCHLORAMID UPON HEMOLYTIC STREPTOCOCCI AND STAPHYLOCOCCI IN WOUNDS OF RABBITS*

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THE problem of prevention and treatment of wound infections is of paramount importance at the present time. During the last few years sulfonamides have been extensively used both systematically and locally. Although many publications are available attesting to the usefulness of these drugs, other observers have reported more or less disappointing results, particularly as far as their effects on localized infections are concerned.

Several successful attempts have been made recently to enhance the antimicrobial activity of sulfonamides. It has been shown that the combined use of sulfonamides and certain disinfectants may yield results superior to those obtained with either drug alone. Tenenberg, Tsuchiya, Clark, and Strakosch[1] demonstrated the synergistic action *in vitro* of sulfonamides and urea. Clinically, Holder and MacKay,[2] Strakosch and Clark,[3] and Ilfeld[4] have used urea and sulfonamides in combination with gratifying results. Sulfonamides and azochloramid, too, act synergistically *in vitro* (Schmelkes and Wyss,[5] Neter[6,7]). It seemed of interest, therefore, to determine their effects under *in vivo* conditions. The following experimental investigation is concerned with the antimicrobial action of sulfanilamide and azochloramid, alone and in combination, upon hemolytic streptococci and staphylococci in wounds of rabbits. The results of this study are herewith presented.

MATERIAL AND METHODS

All experiments were carried out on medium-sized rabbits. The following method was used to produce artificial wounds: The hair was removed with scissors over a large area of the dorsum of the rabbit extending from the neck to the rump and laterally to the flank. At selected places at both sides of the midline the skin was held by a forceps and removed with scissors so that a circular wound measuring approximately 10 to 15 mm. in diameter resulted. Usually no bleeding occurred from this procedure. The wounds were then infected with broth cultures of either hemolytic streptococcus or staphylococcus.* In some of the experiments a sterile swab was saturated with the broth culture and applied to the wound. In others, several drops of the culture were rubbed in with a sterile swab. The majority of experiments were carried out with beta hemolytic streptococcus. Several strains were employed. On strain, C203, was obtained through the courtesy of Dr. Eleanor A. Bliss, Johns Hopkins University. The others were freshly isolated from patients with streptococcal infections. Strains of pathogenic (coagulase-positive) staphylococci, recently obtained from children with staphylococcal infections, were also used.

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* A box was designed and constructed by one of us (T. G. L.) to restrain the rabbit from interfering with the experiment. The head of the rabbit was kept in a stock.

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Two preparations of azochloramid-sulfanilamide powder* of the following composition were used:

Sulfanilamide USP	75.0%
CaCO$_3$	10.0%
Urea	9.5%
Na$_2$HPO$_4$	5.0%
Na tetradecyl sulfate	0.3%
Azochloramid (N, N'-Dichloroazodicarbonamidine)	0.1%
Sulfanilamide	84.5%
CaCO$_3$	10.0%
Disodium phosphate	5.0%
Na tetradecyl sulfate	0.3%
Azochloramid	0.2%

Sulfafilm containing 15% of sulfanilamid, buffered to pH 8.5–9, as well as control film without sulfanilamide, were also supplied by Wallace & Tiernan Products, Inc.

In order to determine the effects of sulfonamides and azochloramid upon streptococci and staphylococci in wounds, cultures were made prior to and during therapy. Sterile swabs were applied to the wound and rubbed with firm pressure. When crusts were present they were first removed and the culture was taken from the exposed wound. Blood agar was then inoculated from this swab. The culture medium was prepared with 5 per cent human blood; it contained para-aminobenzoic acid to counteract any possible antimicrobial effects resulting from the presence of sulfonamides in the inoculum. In some experiments sodium sulfite was added to the agar to render azochloramid ineffective. The agar plates were incubated at 37°C. for several days and the resulting growth was noted at intervals.

EXPERIMENT

In preliminary experiments it was determined whether artificial wounds in rabbits could be infected with the strains of hemolytic streptococci and staphylococci available for these studies. Since undiluted eighteen to twenty-four-hour broth cultures were employed, it is evident that a large number of organisms were used for infecting purposes. It was noted that this method resulted in the presence of numerous viable micro-organisms in the wounds for at least forty-eight hours. Purulent infection usually did not develop and the number of viable organisms decreased within two to four days even without treatment.

In the first experiment the effects of azochloramid powder on hemolytic streptococcus in wounds of rabbits were studied. An eighteen-hour infusion broth culture of beta hemolytic streptococcus (C_{203}) was used. One wound was treated with this drug, the other served as control. The wounds were cultured for the presence or absence of hemolytic streptococci on blood agar containing para-aminobenzoic acid and sodium sulfite, after the azochloramid powder has been removed mechanically. Then, azochloramid powder was reapplied to the wound. The results of this experiment are presented in Table I.

TABLE I

EFFECT OF AZOCHLORAMID POWDER ON HEMOLYTIC STREPTOCOCCUS IN WOUND OF RABBIT

Culture of Na$_2$SO$_3$ Blood Agar	Wound Treated with Azochloramid	Control Wound
1. Immediately after treatment.	Many hem. strep.	Very many hem. strep.
2. 5 minutes after treatment.	Few hem. strep.	Very many hem. strep.
3. 30 minutes after treatment	No. hem. strep.	Very many hem. strep.

It is evident from this table that (1) hemolytic streptococci were still present immediately after azochloramid was applied, (2) exposure of the wound to azochloramid powder for five and thirty minutes, respectively, resulted in a marked reduction in the number of viable hemolytic streptococci, and (3) a large number of hemolytic streptococci were present in the control wound. Thus, azochloramid exerted definite anti-streptococcal activity

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* Azochloramid as well as azochloramid-sulfanilamide powder was supplied by Wallace & Tiernan Products, Inc., through the kindness of the late F. C. Schmelkes and of L. Reiner.

in vivo. This conclusion is based on two facts: (1) the observation that immediately after the drug was applied many hemolytic streptococci were still present and (2) that sodium sulfite was used in the culture medium to counteract the bacteriostatic effects of azochloramid *in vitro*.

Since *in vitro* experiments had revealed that azochloramid and sulfonamides act synergistically, the effects of these two drugs, alone and in combination, on hemolytic streptococcus were investigated. The results of such an experiment are summarized in Table II.

It may be seen from this table that sulfanilamide powder alone failed to reduce materially the number of hemolytic streptococci in the wound over a period of forty-eight hours; in contrast, azochloramid powder alone, as well as azochloramid powder used in conjunction with sulfanilamide, caused a definite reduction in the number of organisms twenty-four hours after treatment was begun. It must be emphasized, however, that certain irregularities occurred. For instance, the wound treated with azochloramid and sulfanilamide after forty-eight hours again harbored many hemolytic streptococci. In all, thirty-five such experiments were carried out. It is evident from these experiments that, generally speaking, azochloramid powder definitely reduced the number of hemolytic streptococci present in such wounds; furthermore, no evidence has been obtained indicating that the combined use of azochloramid and sulfanilamide resulted in greater antimicrobial effects than that obtained with azochloramid alone. This may be due to the fact that azochloramid in itself proved to be efficacious and that additive effects from the additional use of sulfanilamide escaped detection. Furthermore, it must be noted that even in the control wounds hemolytic streptococci had practically disappeared after seventy-two hours and it is quite possible that sulfonamides exert their anti-streptococcal activity especially after a lapse of several days.

TABLE II

EFFECT OF SULFANILAMIDE WITH AZOCHLORAMID POWDER ON HEMOLYTIC STREPTOCOCCUS IN WOUND OF RABBIT

Culture on Blood Agar	Wound Treated with Azochloramid	Wound Treated with Sulfanilamide	Wound Treated with Sulfanilamide and Azochloramid	Control Wound
1. Few minutes after treatment.	Many hem. strep.	Very many hem. strep.	Rare hem. strep.	
2. 24 hours after treatment.	Rare hem. strep.	Very many hem. strep.	Few hem. strep.	Many hem. strep.
3. 48 hours after treatment.	Rare hem. strep.	Very many hem. strep.	Many hem. strep.	Very many hem. strep.
4. 72 hours after treatment.	No hem. strep.	Rare hem. strep.	Rare hem. strep.	No hem. strep.

Recently, films impregnated with sulfonamides have been introduced in the prevention of wound infections. It was decided, therefore, to study the effects of such a preparation, sulfafilm, on hemolytic streptococcus in wounds of rabbits. The experiment itself was carried out as follows: Five wounds were infected with a freshly isolated strain of hemolytic streptococcus. One of the wounds served as control, the others were treated with (1) sulfafilm, (2) sulfanilamide-azochloramid powder, (3) sulfanilamide-azochloramid powder and sulfafilm, and (4) sulfanilamide-azochloramid powder and control film, respectively. Cultures were taken at various intervals. The results are presented in Table III. It is evident that sulfafilm itself failed to reduce the number of hemolytic streptococci in wounds. Azochloramid-sulfanilamide powder alone, or used in conjunction with sulfafilm and control film caused a marked decrease in the number of hemolytic streptococci. There was no evidence that the use of sulfafilm increased the antimicrobial effects of azochloramid-sulfanilamide powder. In other experiments, wounds treated with azochloramid powder and sulfafilm contained fewer hemolytic streptococci than those treated without the film. However, the results were inconsistent and control film produced similar effects.

In the last series of experiments the effects of azochloramid and sulfanilamide on staphylococci in wounds of rabbits was investigated. The results of a representative experiment are presented in Table IV. This table shows that sulfafilm alone had no noticeable effect on the number of staphylococci present. Sulfanilamide-azochloramid powder caused only transitory reduction in the number of organisms present. The additional use of sulfafilm did not inhance the activity of sulfanilamide-azochloramid powder. Similar results were obtained in repeated experiments.

TABLE III

EFFECT OF SULFANILAMIDE WITH AZOCHLORAMID AND SULFAFILM ON HEMOLYTIC STREPTOCOCCUS IN WOUND OF RABBIT

Culture on Blood Agar	Wound Treated with Sulfafilm	Wound Treated with Sulfanilamide and Azochloramid	Wound Treated with Sulfanilamide, Azochloramid and Sulfafilm	Wound Treated with Sulfanilamide, Azochloramid and Control Film	Control Wound
1. Few minutes after treatment.	Very many hem. strep.	Moderate number of hem. strep.	No hem. strep.	Moderate number of hem. strep.	Very many hem. strep.
2. 24 hours after treatment.	Very many hem. strep.	No hem. strep.	No hem. strep.	No hem. strep.	Very many hem. strep.

TABLE IV

EFFECT OF SULFANILAMIDE, AZOCHLORAMID AND SULFAFILM ON STAPHYLOCOCCUS IN WOUND OF RABBIT

Culture on Blood Agar	Wound Treated with Sulfafilm	Wound Treated with Sulfanilamide and Azochloramid	Wound Treated with Sulfanilamide, Azochloramid and Sulfafilm	Control Wound
1. Few minutes after treatment..................	Very many staph.	Scattered staph.	Rare staph.	Very many staph.
2. 24 hours after treatment.	Very many staph.	Very many staph.	Many staph.	Very many staph.

COMMENTS

The problem of the most effective measures for the prevention and treatment of wound infections is still in a state of flux. Its significance at the present time cannot be overestimated. On the one hand, there have been published during the last few years favorable reports concerning the efficacy of sulfonamides applied locally or given systemically. On the other hand, it has been shown by other authors that these drugs failed materially to reduce the number of pathogenic micro-organisms in wounds. The subject of sulfonamide therapy in wound infections has been reviewed recently by Lyons,[8] Long,[9] and Lund.[10]

Jensen, Johnsrud, and Nelson[11] were among the first to use sulfonamides locally in compound fractures with gratifying results. Sulfonamides were recommended for the prevention and treatment of wound infections by Long,[9] Riba and Aten,[12] Green and Parkin,[13] Weil, Whitaker, and Rusbridge,[14] and the National Research Council, Committee on Chemotherapeutic Agents,[15] among others. Meleney,[16] before the Buffalo Academy of Medicine, reported that our figures give no indication that the sulfonamide-treated patients had a lower incidence of local wound infection than the control cases, and the important bacteria were not more completely eliminated from the wounds in the drug-treated patients than from the controls without the drug.

Experimentally, McSwain and Glenn[17] studied the effects of local implantation of sulfadiazine in streptococcal infections. These authors found that this treatment reduced the mortality rate from 100 to 66 per cent and 83.4 per cent, respectively, depending upon the time elapsing before treatment was begun. Implantation of sulfadiazine also lowered the incidence of positive blood cultures from 100 to 50 per cent. It is noteworthy that this form of therapy had very little influence on the micro-organisms present in the wound. The incidence of positive wound cultures was reduced from 100 to only 83 per cent, 91.7 to 100 per cent. Thus it is evident that local sulfathiazole therapy influenced the systemic infection to a greater extent than the local infection.

Daniel, Billings, and Crutcher[18] investigated the local effect of sulfanilamide, sulfathiazole, and sulfadiazine upon hemolytic staphylococcus aureus infections of the pleural cavity. They found that local use of sulfathiazole is more effective in preventing hemolytic staphylococcal empyema following pneumonectomy in the dog than are either sulfanilamide or sulfadiazine. Sulfanilamide proved least efficacious.

Lord, Blakemore, and Stefko[19] investigated the effect of sulfonamides in wounds using the non-suture method of bridging a gap in the several femoral artery twenty-four hours after its unsterile ligation and division. They found that in the undébrided wound local implantation of sulfanilamide was of little value in regard to the healing of the wound, whereas, in the carefully débrided wound sulfanilamide applied locally was of significant value. It is worth noting that sulfathiazole administered orally was slightly more efficacious than sulfanilamide implanted locally.

The above reported experiments were undertaken to compare the antimicrobial effects of sulfanilamide and azochloramid upon hemolytic streptococci and staphylococci in wounds of rabbits and to determine whether these drugs act synergistically *in vivo* as they do *in vitro.* The investigations revealed that against hemolytic streptococcus, isolated from human sources, sulfanilamide powder as well as sulfafilm failed to cause a noticeable reduction in the number of organisms present. It must be stressed, however, that in these experiments the infection was self-limited, since the organisms disappeared without treatment after several days. Furthermore, it is noteworthy that the artificial wounds were infected with large numbers of hemolytic streptococci. In contrast to sulfanilamide, azochloramid powder as well as azochloramid-sulfanilamide powder markedly reduced the number of hemolytic streptococci present in such wounds. Against pathogenic staphylococci azochloramid was less effective than against hemolytic streptococci. This drug only temporarily reduced the number of staphylococci in wounds of rabbits.

Under the conditions of these experiments the simultaneous use of azochloramid and sulfanilamide did not produce better results than did azochloramid alone. Several possibilities have to be considered to explain this observation: First, it is possible, although unlikely, that these drugs do not act synergistically *in vivo* as they do *in vitro.* Secondly, it may be that the synergistic action escaped detection since azochloramid alone usually produced a marked reduction in the number of organisms. It remains to be determined, therefore, whether synergistic effects can be demonstrated in experiments in which slightly effective amounts of azochloramid are employed.

In this connection it is worth mentioning that mixtures of azochloramid and sulfanilamide, both in powder form and in solution (triacetin), have been used in the treatment of wound infections at this hospital in several cases. The treatment was well tolerated and the results, by and large, were very encouraging. The treatment seems to be of value particularly prior to grafting.

From the data presented here it is evident that azochloramid powder is definitely more efficacious toward hemolytic streptococci and staphylococci in wounds of rabbits than is sulfanilamide. It is reasonable to suggest, therefore, that azochloramid or other oxidizing agents, alone or in conjunction with sulfonamides, be studied further as antimicrobial agents for the prevention and treatment of wound infections.

SUMMARY

The effects of azochloramid powder, sulfanilamide powder, and sulfafilm, alone and in combination, on beta hemolytic streptococci and staphylococci of human origin in artificial wounds of rabbits were investigated. The following results were obtained:

1. Hemolytic streptococci were present in infected wounds for two to four days and then disappeared without specific treatment.

2. Within an observation period of twenty-four to forty-eight hours sulfanilamide powder and sulfanilamide-impregnated film failed materially to reduce the number of hemolytic streptococci in such wounds.

3. Azochloramid powder and azochloramid-sulfanilamide powder caused a marked reduction in the number of organisms present.

4. The experiments did not reveal any synergistic action of azochloramid and sulfanilamide on hemolytic streptococci in such wounds.

5. Wounds infected with human pathogenic staphylococci were similarly treated. Sulfanilamide powder and sulfafilm proved to be ineffective. Azochloramid powder and azochloramid-sulfanilamide powder caused only a moderate and temporary reduction in the number of organisms.

6. Mixtures of azochloramid and sulfanilamide have been used with encouraging results in the treatment of wound infections in children.

7. The significance of the results is discussed.

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The response to the treatment of varicose ulceration depends on its duration, the extent of the ulceration, and the condition of the surrounding tissues in terms of scarring, phlebitis and lymphatic obstruction.

From "Minor Surgery," edited by Humphry Rolleston and Alan Moncrieff (Philosophical Library).

BENIGN TUMORS OF THE STOMACH

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THE importance of benign tumors of the stomach has repeatedly been emphasized in the literature. The main reasons for this fact are evidently: first, the severity of the symptoms and second, the frequency of malignant degeneration.

Lesions of this kind are relatively rare. They may appear singly or in multiple form, submucous or subserous, sessile or pedunculated. Their incidence is variously estimated at from 0.5 to 5 per cent of gastric neoplasms. Finesilver, at the New York Hospital, reports an estimated 43,200 gastrointestinal *x*-ray series taken in the course of eight years, of which only six showed benign tumors. In addition, there were in this series three cases which had undergone malignant change. The ratio of malignant to benign tumors was 66 to 1. Root, at the Cleveland Clinic, found only seventeen benign gastric tumors in 250,000 admissions, and of these twelve were proved at operation or autopsy. Lahey and Colcock quote Rigler and Erickson who, in 6,742 autopsies at the University of Minnesota found that benign tumors formed 26 per cent of gastric neoplasms. Many of the benign tumors encountered at autopsy are leiomyomas of less than 1 cm. in diameter, which had caused no clinical symptoms.

These benign tumors are classified as epithelial, mesenchymal and endothelial. Of these the leiomyomas are the most common, adenomas and papillomas come next in frequency, while neurofibromas and hemangiomas are quite rare.

Little is known concerning the etiology of these tumors. Considerable experimental work has been done with rats and mice, using roughage and unbalanced or deficient diets. Brunschwig and Rasmussen conclude that no proof exists that deficiencies in vitamins A, B_1, B_2, C or D are definite factors in the development of these tumors.

Atrophic gastritis is a common finding accompanying benign tumors of the stomach. Schindler, in examining 2,167 stomachs gastroscopically, found thirty-six adenomatous polyps, an incidence of 1.65 per cent. Two-thirds of these cases showed atrophic gastritis. Among a total of 310 patients suffering from atrophic gastritis, adenomatous polyps were present in 4.8 per cent. Of forty-three patients with pernicious anemia and severe widespread atrophic gastritis, 14 per cent had benign adenomatous polyps. Thus, adenomatous polyps are seven times more frequent in association with atrophic gastritis than in the presence of a normal mucosa.

Ulceration of the mucous membrane over the surface of these tumors is quite common and tends to be deeply penetrating.

Malignant change or degeneration in benign tumors of the stomach is frequently encountered. Lahey and Colcock found sarcomatous degeneration in five out of seven leiomyomas. Eliason and Wright, as quoted by Lahey and Colcock, report malignant change in 35 per cent of adenomatous polyps. McRoberts, of the Mayo Clinic, as quoted by Finesilver, classed four out of five adenomas as malignant. Such malignant transformation is encountered in similar manner in the less common fibromas, neurofibromas and hemangiomas.

Symptoms vary according to size, the location, the presence of ulceration, the presence of atrophic gastritis and are also dependent upon the tumor being either sessile or pedunculated. The average case will have been subject to symptoms for about eighteen months. Some form of dyspepsia is usual and vomiting occurs in about one-third of all cases. Many have been treated for peptic ulcer for some time, with varying relief. Anemia is the most common finding. Bleeding in ulcerated cases may either be mild or severe. Unexplained anemia may be the only sign, and benign tumor of the stomach must be kept in mind as a possible source of bleeding in such cases. Finesilver quotes Benedict and Allen, of the Massachusetts General Hospital, as reporting primary anemia as the first diagnosis in 30 per cent of their cases. On the other hand, severe hemorrhage with hematemesis and melena is not uncommon and may even be fatal. In approximately 10 per cent of these cases pedunculated tumors near the pylorus cause obstruction of the ball-valve type, usually intermittent in character. In these cases pain may be a prominent complaint. Prolapse of the tumor through the pylorus and even intussusception have been described.

In the diagnosis, roentgen ray and gastroscope are most important. The roentgen findings are characteristic and consist of smooth, punched out filling defects, most easily seen in the partially filled stomach. Peristalsis is only slightly interfered with, and surface ulcers are readily demonstrated. Rugae commonly are normal to the base of the tumor. The gastroscope is of value, especially in viewing the smaller tumors. Large tumors may be seen only in part and in such cases roentgen examination is more trustworthy. Laboratory findings are variable. Achlorhydria and anemia are frequently noted.

Benign tumors of the stomach are rarely palpable save at operation. Even with the tumor under vision, at the operating table, it is difficult to arrive at an accurate diagnosis concerning this group of gastric neoplasms. For this reason, it is generally agreed that one must depend upon histological examination for final diagnosis. Enlarged inflammatory lymph nodes may be present, making a benign ulcerated tumor appear malignant, yet metastases may be present in a tumor seemingly benign.

Surgical treatment of these cases is generally satisfactory and the mortality low. Some writers urge gastric resection, giving these tumors a wide berth; others believe that simple, local resection of the lesion is adequate and less hazardous. Zollinger, in summing up the problem, writes: "The type of surgery carried out will depend on the extent of the lesion, its location and its probable chance of being malignant." Frozen section may be of aid, but is not entirely reliable in differentiating between benign tumors and the lower grades of malignancy.

The following case reports are from the files of the Huntington Memorial Hospital in Pasadena, California, and include all cases of this type, admitted during the past twenty years. It should be noted that two out of four myomas of the stomach had undergone malignant degeneration.

CASE REPORTS

Case i. J. R., seventy years of age, male, upon his first admission, stated that six months previous he had passed a large dark stool and had several black tarry stools since. At 4 A.M. he vomited a large amount of bright red blood and was very weak and unable to walk. *X*-ray suggested a possible benign myoma. Operation was advised and refused. The patient remained in the hospital eight days.

He was readmitted twenty-five months later. He had been well since last hospitalization until three weeks before this admission when he felt weak and faint. He experienced pain in the epigastrum, nausea, and vomited a quantity of blood and later passed a tarry stool. He had been able to eat little since and had lost considerable weight. Hemorrhages had been repeated. *X*-ray showed that the tumor still had benign characteristics.

At operation a local excision was performed and the histology proved the presence of myoma of the stomach with malignant degeneration and ulceration. (Figs. 1A, B and C.)

Case ii. S. D., a sixty-seven year old female, complained of loss of appetite, diarrhea, and sense of a lump in the left side for the past four months. The feeling in the upper abdomen was the same as when she felt life during pregnancy. Weight loss had been eight pounds.

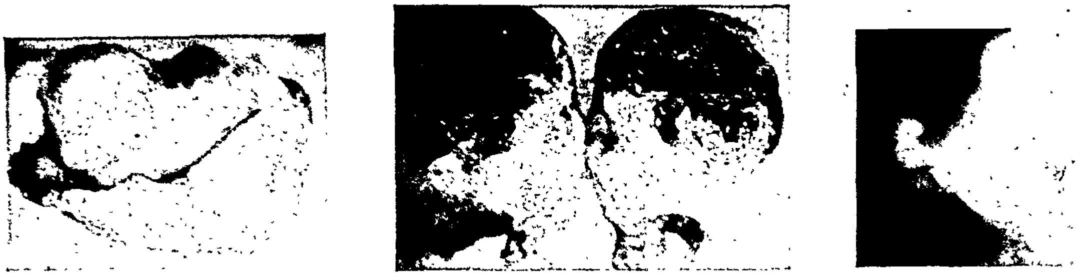
A B C

Fig. 1. A, gross appearance of tumor; B, tumor sectioned, showing hemorrhagic infiltratration; C, roentgenogram.

A movable, non-tender, firm mass 7 cm. in diameter, was palpable beneath the left costal margin. It could be pushed to the mid-line and down to the umbilicus. There was marked Paget's disease in both legs, especially the right. Colon x-ray was negative.

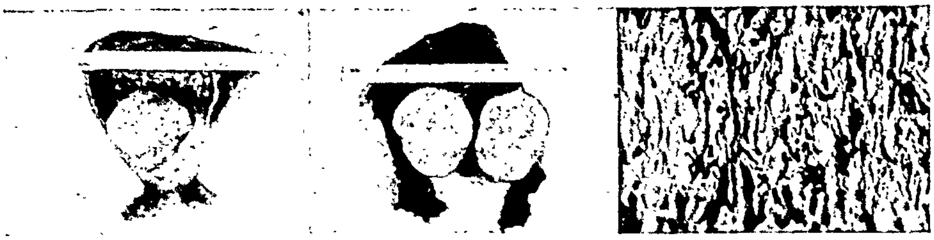
A B C

Fig. 2. A, gross appearance of mucosal surface; B, tumor sectioned; C, microphotograph.

Sleeve resection was carried out and a subserous discrete, firm, rounded tumor was found arising from the posterior wall of the fundus of the stomach. The serous surface was nodular, suggesting possible invasion of serosa. The histological picture was that of a benign myoma and chronic gastritis. (Figs. 2A, B and C.)

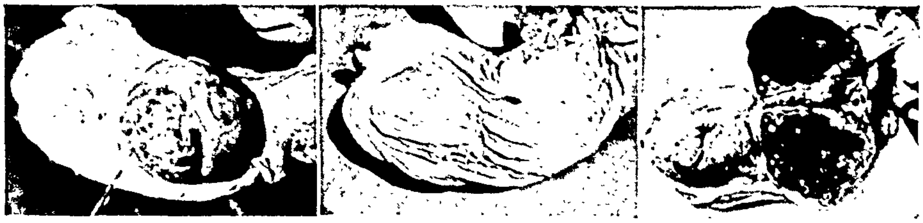
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Fig. 3. A, serosal surface; B, mucosal surface, showing ulceration; C, tumor section showing hemorrhagic infiltration.

Case III. F. E., a fifty-five year old female, had a sudden onset of nausea, hematemesis and epigastric pain four days before admission. Repeated hemorrhages occurred since, combined with epigastric pain. Her condition was poor on admission, red blood count 1,680,000; hemoglobin 32 per cent. Repeated transfusions were given, but the patient went steadily down, dying of hemorrhage. No operation was performed, the red blood count was 640,000; hemoglobin was not readable. The autopsy specimen showed malignant myoma of the stomach with ulceration. (Figs. 3A, B and C.)

Case IV. F. B., a sixty-seven year old male, had passed black tarry stools and suffered with some gas and discomfort six months previously. The night before hospitalization he passed a similar black stool, at 8 P.M. He felt uncomfortable later in the night and went to the bathroom, where he was found unconscious lying in a pool of blood, at 5.30 A.M. A blood transfusion was given.

X-ray showed tumor of the stomach wall with ulceration.

The patient gradually improved and left the hospital on the thirty-seventh day. He returned three months later with a red blood count of 3,640,000 and hemoglobin of 45.4 per cent. Operation was performed and transfusions given. The histological picture was that of fibromyoma of the stomach, benign. No photographs were available in this case.

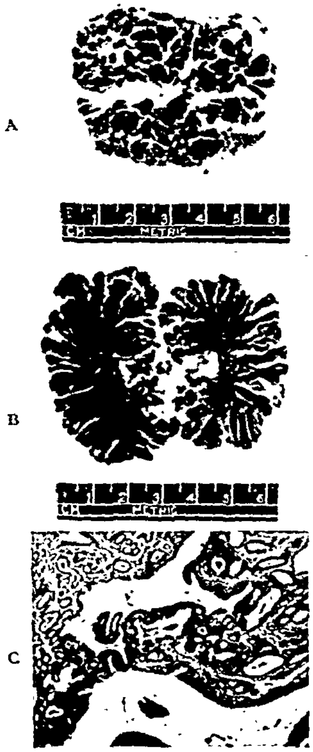

FIG. 4. A, gross appearance; B, tumor sectioned; C, microphotograph.

CASE V. F. H., a fifty year old male, had had intermittent periods of sharp mid-epigastric pain, gaseous distention and recurring constipation for nine months. The pain occurred usually in the morning and was aggravated by the ingestion of food. There were no nausea, vomiting, nor tarry stools.

X-ray showed a defect consistent with tumor encroaching upon the lumen of the stomach. During local excision a soft pedunculated tumor on the posterior wall was removed. The histological picture was that of a benign papilloma. (Figs. 4A, B and C.)

CONCLUSION

Benign tumors of the stomach while rare, are important. The symptoms they produce may be severe. Malignant degeneration is frequently encountered. Their surgical treatment is satisfactory and the mortality is low.

More frequent roentgen and gastroscopic study of the stomach in cases of unexplained anemia and chronic dyspepsia is urged.

Appreciation is expressed to Dr. J. H. Breyer, Dr. S. J. Mattison and Dr. C. C. Snyder for the use of their material along with my own, and to the Pathology Department for aid in preparing the photographs.

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PSYCHOLOGY OF THE PATIENT UNDERGOING PLASTIC SURGERY

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IN recent years medical literature has revealed a decided increase in the number of articles on the subject of plastic surgery. For the most part the papers deal with specific technical problems, and little has been written on the psychology of the patient undergoing plastic surgery. It is not the intent here to convey the impression that this paper constitutes a thorough study of the psychology of such a patient. The purpose is merely to call attention to certain facts, some perhaps well known, others less well known, and still others scarcely realized.

As surgeons, we are all too prone to look upon the patient as a case of this or that type of disfigurement. We see only "the point of our knife." Yet the genuine success of the surgical treatment cannot be measured in terms of physical results alone.

The surgeon knows what he may expect to do for his patient physically. But why a more or less identical result, honestly satisfactory from the surgeon's standpoint, will satisfy one patient yet not another; why in this respect the surgeon is successful with one patient and not with another; why some patients continue to drift from one surgeon to another without, apparently, getting relief, all these questions cannot be settled from a consideration of the physical defect and the surgical treatment alone. And this problem becomes even more puzzling when the surgeon recalls certain cases in which the physical results were not, from his point of view, entirely satisfactory but in which, nevertheless, the patient felt much improved and free from the mental distress which he had previously experienced.

To dismiss casually the patient who is unhappy over the results of a plastic operation by saying that such a patient is ungrateful or "crazy" is generally to evade the real issue. Not only must the surgeon ask himself, has the operation been honestly executed, and is he himself sincerely satisfied with the surgical result? But he must search his memory and conscience further. Was the outcome clearly prophesied to the patient? Was the patient at any time misled to expect a better result? And there are still further questions: Was surgery really needed in the first place? Has the surgeon a clear insight into the patient's mental attitude and has he had it from the very beginning?

Our discussion, then, makes no claim to completeness, but it does attempt to set down a few observations concerning the psychology of the patient, and these observations may be grouped about the following problems: (1) Objective considerations, i.e., the physical disfigurement itself and related factors; (2) subjective considerations, such as anxiety and related fears; (3) the relation between disfigurement and mental distress, or between subjective and objective conditions.

THE PHYSICAL DISFIGUREMENT

No hard and fast rule can be set down as to what constitutes a genuine disfigurement. In contrast to large and obvious defects, there are others so slight that one's attention must literally be called to them. And between these two extremes lie all possible gradations. The dividing line between a genuine defect and a fancied one is sometimes very vague. A condition which to the surgeon may seem of slight import, may be of tremendous significance to the patient.

There is in most of us a very human desire to conform to the standards of our society. We are not here concerned with the question of what factors mould our concept of desirable "looks"; that would involve a discussion of fashion, the arts, the dominant social group, etc. But whatever the genesis of the standard physical pattern, both from the general social standpoint and from the individual's standpoint, failure to conform to the accepted pattern sets one apart in one's own estimation, and is often the basis for feelings of acute anxiety.

From an objective point of view alone, the surgeon must consider first of all the disfigurement itself and the possibility of repair *if such repair is at all possible.* Certain practical considerations should be taken into account: the patient's age, sex, occupation, social position, his economic and marital status. From a purely objective point of view, repair might seem to be more important in the case of a young person who has his life to live than in the case of an old person whose life is largely behind him, and, given our social order, more important to a woman than to a man. From this external point of view it might also seem that surgical repair of a defect is more urgent in certain occupations than in others, let us say, for instance, more essential to an actress or to a personage in public life than to a dishwasher or a housewife. But from a subjective point of view this may not be true.

SUBJECTIVE CONSIDERATIONS

Just as important as the objective consideration of a defect, is the surgeon's understanding of the patient's mental attitude. In the final analysis, what constitutes a disfigurement rests in large measure with the patient's reaction to that real or fancied disfigurement. We must constantly bear in mind that the patient's attitude toward the physical problem is based not only upon the objective extent of that problem but on related subjective factors of personal adjustment to the outer world.

The plastic surgeon who contemplates the operative treatment of a patient suffering from a real or fancied disfigurement must make every effort to comprehend that patient's mental attitude. While he cannot be expected to be a psychiatrist, the surgeon must never permit his point of view to be restricted to mere consideration of the actual physical repair alone. He must adopt a broader outlook and *treat the patient,* not merely the local condition.

For the patient's mental attitude is of crucial importance. It is the mental attitude which accounts for the fact that a patient will readily submit to extensive surgery. In that initital attitude, the patient undergoing plastic surgery differs from the ordinary surgical patient, for the former comes to the surgeon in the hope that he will be subjected to operation, whereas the general surgical patient comes to the surgeon in the hope that he will be told no surgery is necessary. The one courts surgery, the other dreads it. This desire on the part of the patient for plastic surgery renders him peculiarly vulnerable, since those whose commercial ability far exceeds their professional skill may take advantage of his eagerness.

Moreover, the patient is often inclined to expect too much from the surgeon. His expectation may be beyond the surgeon's ability to fulfill, either because there is no actual surgical solution for the physical problem, or because surgical repair, even if possible, cannot solve that patient's psychological problem. As regards the first factor—the possibility of physical repair—the surgeon's approach must be cautious. When the general question of repair is discussed, the prognosis should be scrupulously presented. For instance, if grafting of tissue is indicated, the possibility, if any, of disfigurement in the donor area should be pointed out. Hospitalization, postoperative discomfort both from the operation itself and from possible immobilization should be considered. And, so far as possible, the final result must be described. These points should be presented to the patient as simply and as clearly as possible, without minimizing them.

DISFIGUREMENT AND MENTAL DISTRESS

So much for the question of physical repair. But the patient who has a physical disfigurement has an accompanying anxiety, a mental distress, for as we have seen it is because of his mental reaction to the disfigurement that the patient seeks plastic surgery, and even where complete surgical repair is possible, it may not solve the patient's psychological problem. The terms distress and anxiety are used here in a broad sense, including such mental and emotional attitudes and mechanisms as inferiority, shame, overcompensation; and such psycho-emotional traits as an antisocial tendency, social insecurity, general maladjustment. One might be inclined to assume that the anxiety ought to bear a definite proportional relationship to the disfigurement. Strangely enough, this is not always the case; there is no definite proportional relationship between the disfigurement and the mental attitude it engenders. What to the surgeon may appear an almost insignificant disfigurement may be accompanied by an extreme anxiety in the patient; and the reverse situation is as frequently encountered, with a patient whose marked disfigurement occasions in him little or no mental distress.

For example, I recently saw two patients whose psychological attitudes contrasted strangely. The first was a young man in his thirties, suffering from pulmonary tuberculosis and epilepsy, whose nose and all four eyelids had been destroyed by burns. Yet in spite of this extensive disfigurement he displayed little, if any, mental distress. His cheerfulness, his sanguine and wholesome attitude were in distinct opposition to that of the second case, a young woman singularly unattractive, with acne scars of the face, who had a burn about a quarter-inch in diameter (heating-pad burn) on the cheek, yet who exhibited deep anxiety over her slight disfigurement, completely ignoring the fact that the burn scar was scarcely discernible among the acne scars.

Just as an objective evaluation of the physical extent or severity of a disfigurement bears no inevitable relationship to the mental suffering that disfigurement occasions, so the other objective social factors which we mentioned above: age, sex, occupation, socio-economic position, cannot be assumed to bear a definite and predictable relationship to the degree of distress felt by the patient. The actress may be less troubled than the housewife, the public figure less than the dishwasher. We can say only that to stand apart from the accepted physical pattern *may be* the cause of anxiety.

Surgical treatment of a disfigurement, therefore, is only half the problem in plastic surgery, of which the psychological treatment is the other half. Two approaches to the patient are equally essential and equally indispensible: the first, an objective consideration of the *defect* and the practicability of remedying it; the second, a consideration of the *patient* and the possibility of achieving a result that will prove satisfying to him. Consideration of the patient involves consideration of his anxiety, needs or motives, the relationship of the total distress to the disfigurement itself, and the rôle of that disfigurement in the patient's general psychological make-up. To direct all one's energy toward one phase of the patient's illness and to disregard the other is comparable to eradicating a malignancy but neglecting the metastasis, or treating the metastasis and ignoring the malignancy.

Frequently a patient's anxiety seems so deep-seated that we classify him as neurotic, as indeed he may be. However, an effort must be made to distinguish between the basic neurotic and the situational neurotic. In the latter type, the personality itself is undistorted, but a neurosis develops in response to a definite external situation pregnant with conflict. There is no real neurotic personality here, but merely a temporary lack of adaptation to a particular, trying situation. In this type of patient (i.e., with distress or anxiety limited to the disfigurement) the psychological state is the reflection of a definite physical defect and surgical repair will relieve the anxiety just as it will repair the defect.

On the other hand, the result of surgery will be quite different if one is dealing with a basic neurotic personality. Here the patient (for whom the disfigurement may be only a focus for some more basic maladjustment), will, after surgery, quickly find another symptom through which to channel the neurosis. The surgeon who disregards caution and operates upon the basic neurotic will soon find reason to regret having done so. The general surgeon is guided by physical signs; but physical signs alone are not sufficient for the plastic surgeon who must consider a psychic as well as a physical outcome. In my own experience, it may categorically be stated that surgery in the basic neurotic is not effective therapeutically.

Surgical reponsibility in the borderline case which lies midway between the clearly basic and the situational neurosis is not to be ignored nor treated lightly. Just as we have no hesitation in analyzing the patient's blood or in *x*-raying, so we must not be reluctant to investigate his psychological state and, further, to distinguish between the situational and the basic neurosis in the definitely neurotic patient. In general, the patient's history will serve as material for diagnosis, and the specific case may be illuminated by such sample considerations as the following. How did the early family environment account for lack of early security? Is there general emotional instability? Is there lack of social and occupational adjustment? If the defect was acquired and not congenital, what was the patient's emotional status prior to the disfigurement? What effect has the disfigurement had on formation of the patient's present personality?

Finally, in cases in which the patient cannot be completely restored by physical repair, guidance and encouragement leading the patient toward social rehabilitation and toward a normal place in the social world are as essential as is the strictly physical solution.

PLASTIC SURGERY IN CHILDREN

Plastic surgery in the case of the child brings its own attendant problems peculiar to the child patient alone. It is surprising how early distress over a disfigurement, either congenital or acquired, may manifest itself. In this connection it should be pointed out that awareness of the physical defect occurs as soon as the child is capable of realizing a physical distinction between itself and other children: a "difference" which is of course accentuated by the attention focussed upon it by parents, relatives and playmates.

However, awareness of disfigurement may emerge even before the child is capable of comprehending the spoken word, and may have its origin in the undue attention given by others to the disfigurement, often a non-verbal attention which may take the form of excessive handling of the deformed part, or even of facial expression on the part of parent or visitor or nurse. Comprehension outruns speech, and it is not uncommon for me to see children who are unable to speak but who do understand and who will present, for example, a burned or webbed hand for examination without actually being requested to do so.

It might be said that the best treatment is prophylactic, that, in other words, the child should not be exposed to hazards. Here the problem is bound up, in large measure, with the socio-economic setting. The problem of the disfigured child is one of peculiar importance not only to the child himself but to the entire community. For example, the socially underprivileged child must play in unguarded streets rather than in supervised areas. Further, such a child is exposed to many hazards indoors as well as outdoors, for it is subject to less supervision generally than is the more privileged child.

There are, then, considerations peculiar to the child patient alone and not to the adult patient, as well as elements involved in the treatment of children which are perhaps less significant in the adult than in the child. A child who has, for example, suffered a mutilating injury such as a burn or who, let us say, is injured in the street, has undergone a terrifying as well as a mutilating experience, and is immediately faced with a series of further terrors in a course of treatment which is painful, incomprehensible, bewildering. He is taken to a hospital where he is in the hands of strangers and in an unfamiliar setting. To the actual physical pain which he is suffering are added loneliness and fear. He does not understand what is being done for him, nor to what end the treatment may lead. His inner security is assailed and shaken. It is natural, therefore, that he should act in a defensive manner, fighting back at the doctor or nurse with any weapons at his disposal. He may, for example, find that by screaming and struggling he can evade painful treatment for a time at least. The results of his belligerence and unco-operativeness is either conscious or unconscious neglect on the part of the attendants, or the application of forcible methods to accomplish the treatment. Here again, pain, loneliness and terror enter into the picture. A psychic trauma has from the moment of injury been superimposed upon the physical trauma, and the course of treatment and place of treatment extend both these initial traumas.

In the treatment of physical disfigurement, the surgeon must take all possible precautions to avoid causing, or accentuating, a psychic trauma the effect of which might otherwise persist throughout a lifetime. His approach to an injured or deformed child must be carefully considered. His first effort should be to relieve the pain and quiet the terror. Not only will he repair the physical damage, but he will, to the child too young to be reasoned with, convey a sense of security, calm, relaxation precisely the reverse of that anxiety or fear which parents so often communicate to the child. To the child old enough to understand, the surgeon may adopt an attitude of reason. It has been my experience that in general children are reasonable beings. If, from the very outset, before any additional pain has been inflicted, the surgeon explains in some way what has to be done, the child will usually co-operate. The surgeon must approach this task with tact and sympathy.

Patient understanding, absolute honesty, firmness and great gentleness are essential at all times, and these will in a surprising number of cases bring about helpful co-operation from the child. Along with these general guides to the surgeon's behavior, certain specific technics are helpful. For instance, in the removal of sutures or in doing a dressing that might be painful if the patient were to move, the offer of a small reward of one kind or another will sometimes accomplish wonders. At such a time an obviously playful or absurd remark may change a state of apprehension into one of half-amused toleration of the surgeon's whims, or in any event will provide needed distraction. For instance, an order to the nurse to bring "spinach ice cream" for dinner if the child behaves himself during the dressing, may alleviate tension and markedly facilitate the task at hand. Likewise, engaging the child in some playful argument will serve to distract his attention.

In the course of explanation and of treatment, deceit must never be practiced, either by the surgeon or by any of those others with whom the child comes in contact. For the surgeon must on this score have the co-operation of all who deal with his patient. Of what avail is truthfulness on the surgeon's part if, when a child is to be sent to the operating room, someone else tells him that he is merely going to have an *x*-ray picture taken? The child finds instead that he is taken to the operating room, an ether mask placed over his face, and an anesthetic given. Is it surprising that such a child will struggle and fight with all his strength against those who, his own reason tells him, are enemies? Or that he will remain resentful, hostile and recalcitrant throughout the course of surgical treatment? The surgeon needs urgently the co-operation of all who deal with the child, and should be quick to avail himself of anyone—nurse, interne, maid, porter—to whom the child may, as children do, take a fancy.

Still another complicating factor peculiar to the treatment of children is the attitude of the parents and here, too, the surgeon must seek co-operation. Too often the deep anxiety of the parents is so readily displayed that a child otherwise unable to comprehend its own situation quickly perceives its parents' attitude and becomes frightened. We mentioned earlier that comprehension outruns speech, and it is surprising how readily the attitude of the parent will communicate itself to the child. Even a child scarcely able to understand the spoken word will comprehend the fear in its mother's face and attitude and detect her mood. There is even a language of muscle tension which conveys the mother's anxiety to the child she holds.

It is inevitable for parents to be continuously in the picture where a child patient is concerned. By their oversolicitude or undersolicitude, by their own fears and half-formed knowledge of what the surgeon is trying to accomplish, by their buried sense of guilt toward a child congenitally deformed or injured through parental carelessness, in short by their attitude both toward the patient and the surgeon, they may do incalculable harm to the morale of the child and render a difficult task immeasurably more difficult. And yet co-operation on the part of the parents is vital in many ways. For example, if it is advisable to delay a reparative operation for some reason, the parents must be impressed with the importance of not directing attention to the disfigurement. And neither parental fear nor guilt nor anxiety must touch the child patient. With the child patient, the plastic surgeon faces a two-fold problem, the psychic as well as the physical trauma; and in dealing with psychic trauma he must have the co-operation alike of patient, parents, and attendants.

SUMMARY AND CONCLUSIONS

Not enough attention has been paid by the surgeon to the psychology of the patient seeking plastic surgery. The plastic surgeon should always endeavor to study the personality of his patient, and in doing so the history and environment should be carefully investigated. It must be borne in mind that the patient's reaction to his disfigurement is an important criterion in the decision as to necessity for correction.

The observations on the adult patient have been made from three standpoints: the objective considerations, i.e., the physical disfigurement itself; the subjective considerations, such as anxiety and related fears; the relation between physical disfigurement and mental distress. In this latter connection, it must be remembered that the disfigurement bears no inevitable proportional relationship to the mental distress it may engender.

The child patient is a special problem and one that requires study and care. The early awareness of physical defect is not generally recognized; and just as the surgeon endeavors to erase all stigmas of physical trauma, so, too, he must continually endeavor to avoid psychic trauma. For what will it avail him if, in repairing the body, he damages the spirit?

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FRACTURES OF THE JAW*

AN ANALYSIS OF 212 CASES

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THE cases reported in this paper were admitted to Kings County Hospital over a period of eighteen months. All patients remained at the hospital for at least twenty-four hours, were treated and if there were no contraindications, discharged and followed in the out-patient clinic.

A review of the literature reveals that there have been previous publications of analyses of fractured jaws. In 1926, Ivy and Curtiss analyzed 100 Cases of Fracture of the Mandible. In 1928, Reiter reported fifty Cases. In 1930, Dean reported fifty Cases. In 1934, Winter reported 200 cases of fracture of the mandible. In 1936, Dunning reported 1,065 cases of fractures of the upper and lower jaw. In 1940, Doherty reported 100 cases of fracture of the mandible. The latter report in a large measure compared with previous statistics and it is the aim of the authors of this paper to bring out certain facts not previously reported and also compare our findings with those of other writers.

Sex and Age. In this group of cases 83.5 per cent of the fractures occurred in the male and 16.5 per cent in the female. It is noticed that this is the highest percentage reported as occurring in the female. The increased incidence may in part be accounted for by the increasing rate of auto accidents during this period.

The youngest patient was a three and a half year old boy and the oldest patient was a seventy-four year old woman. The following table indicates the age group and incidence in our series.

No.	Years	Per Cent
1	10	2.3
11	20	11.7
21	30	35.3
31	40	23.5
41	50	16.3
51	60	7.0
61	70	1.8
71	80	.4
Age not known		1.8
Average age		31.4 years

Etiology. The following table shows the percentage of etiological factors.

	Per Cent
Fist blows	59.4
Industrial accidents	18.3
Auto accidents	16.5
Cause not known	2.8
Following tooth extraction	9
Miscellaneous	.9
Pathological	.4

The percentage caused by auto accidents is the highest yet reported.

At this hospital, where there are seven surgical specialities, all with separate services, it was not uncommon for many of the cases to be admitted on services other than the Plastic-Oral Surgical Service. Following are the admissions:

	Per Cent
Plastic and oral service	80.6
Neurosurgical service	11.7
O. P. D.	3.7
General surgery	2.3
E. N. T.	1.4

Any patient with questionable head injuries was admitted on the neurosurgical service and worked up completely by them.

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* From the Department of Oral and Plastic Surgery, Kings County Hospital.

Then the fractures were treated when that service believed the patient was in condition to have further work done. This accounted in many cases for delay in fixation of the fractured jaw and was a factor in the comparatively large percentage of infected cases.

Associated Injuries. Twenty-five per cent had other injuries, as follows:

	No. of Cases
Lacerations of the face	22
Fractured zygoma	10
Fractured skull	8
Fractured nose	5
Fractured malar bone	4
Fractured humerus	2
Fractured radius	1
Fractured clavicle	1

The twenty-two cases of lacerations of the face all required plastic repair.

Time of Admissions.

55.1% admitted on the day of injury
16.0% admitted on the first day after injury
5.1% admitted on the second day after injury
5.1% admitted on the third day after injury
2.8% admitted on the fourth day after injury
15.5% admitted anywhere from the fifth day to nine months after injury

These figures are significant, especially the large percentage of cases not admitted till after the second day.

Time Elapsing from Injury to Fixation.

28% were treated on the day of injury
23% were treated on the first day after injury
12% were treated on the second day after injury
8% were treated on the third day after injury
4% were treated on the fourth day after injury
25% were treated on the fifth day to the one hundredth day after injury

Again a large percentage of cases did not receive treatment until two or more days following injury.

The period of immobilization was difficult to obtain in many cases therefore, no attempt was made to determine the average period of fixation. Many patients were discharged to private practitioners and the subsequent course was not followed. Some of the patients were not seen at stated follow-ups and all contact with them was lost.

Number of Fractures.

59.9% had one fracture
35.8% had two fractures
3.3% had three fractures
.9% had four fractures

This is the first time that four fractures of one jaw (mandible) has been reported. there were two cases as follows:

(1) Caused by a blow of fist—location of fractures:
  (a) right condyle, (b) left ramus, (c) left molar area, (d) right bicuspid area, patient edentulous
(2) Caused by auto accident—location of fractures:
  (a) bilateral condyles, (b) coronoid process, (c) symphysis; the patient subsequently died from severe sepsis

The following cases had three fractures: (1) bilateral condyles and symphysis; (2) condyle, body of mandible and maxilla; (3) bilateral condyle and symphysis; (4) bilateral condyles and premolar area of mandible; (5) condyle, and bilateral fracture of the body of mandible; (6) symphysis, condyle and coronoid, and (7) maxilla (body) and bilateral fracture of body of mandible.

In six of these cases condylar fractures were present, the association of bilateral condyle and symphysis occurring twice. In two cases, fracture of the maxilla occurred, as contributing one fracture of the three.

Jaw Involved	No. of Cases
Mandible	191
Maxilla	16
Maxilla and mandible	5

Dunning stated that in a series of 1,065 fractured jaws he found the maxilla was fractured three times to every thousand fractured mandibles. It is evident that the incidence of fractured maxillae is much higher in this series. Again the period in which these fractures occurred as compared to those of Dunning (1906–1913) was a time in which the automobile accidents were very much more on the increase as a cause of traumatic injuries of the face.

Types of Fracture	Per Cent
Compound	70.2
Simple	19.3
Compound-comminuted	5.6
Simple-compound	4.2
Pathological	.4

The fact that a large percentage of cases were compound fractures explains many of the complications which occurred.

Location of Fractures. In a series of 212 cases of fractures of the jaws there were 305 separate fractures.

Mandible	No. of Fractures	Maxilla	No. of Fractures
Body	194	Alveolus	11
Condyle	51	Body	7
Angle	10	Unilateral fractures of body	4
Coronoid	6		
Ramus	5		
Alveolus	5		

In the mandible eight patients were edentulous. In the maxilla one patient was edentulous.

Teeth in the Line of Fracture. Ninety-eight patients had teeth in the line of fracture; fifty-five were fractured in the second and third molar areas.

The treatment of these 98 fractures as regards the status of the involved teeth may be subdivided as follows:

A. In 47 per cent (forty-six cases) teeth in the line of fracture were left intact until postfixation period. It was often believed that a molar tooth in the posterior fragment was an excellent means of keeping that fragment in good position even until fibrous union took place. Infection occurred in twenty-eight cases (62 per cent). In this largest group in which teeth were not extracted immediately, the percentage of infection was high.

B. In 27 per cent (twenty-seven cases) teeth were extracted immediately. Infection occurred in six cases (22 per cent); no infection was present in twenty-one cases (78 per cent).

When teeth in the line of fracture were removed, the incidence of infection was less than in the group in which teeth had not been removed.

C. In 26 per cent (twenty-five cases) teeth in the line of fracture were not extracted. Infection occurred in ten cases (40 per cent); no infection was present in fifteen cases (60 per cent). In this group in which teeth were not removed, ten cases or 40 per cent became infected.

It should be stated, however, that in series A the teeth were extracted because of cellulitis, beginning pathological change in the osseous structure at the fracture site, or continued septis.

Osteomyelitis. In 212 cases, 31 per cent developed osteomyelitis; thirty cases had sequestra formation; three had definite osteomyelitis on admission, and thirty-four cases showed soft tissue infection only, with no evidence of any bone involvement. All these cases required external incision and drainage.

Treatment. In all cases, the most simple form of fixation was the treatment. When teeth were present and available intermaxillary wiring was the method of fixation. Ninety per cent were treated in this way.

The nine edentulous cases were cared for as follows: circumferential wiring in six cases; Gunning splint in one case; Barton bandage in one case, and edentulous maxilla fracture, no treatment.

Posterior reduction with use of wire in the posterior fragment and plaster head cap was used in eleven cases. The result in six cases was very unsatisfactory. The most common complications being non-union, poor position of fragments and infection. This method of fixation has since been discontinued.

A compound block to hold the posterior fragment in position was used in ten cases with good results especially if the block was used immediately before any over-riding was present. Interosseous wiring was used in three cases for non-union with excellent results. The fractured maxillae were treated with the Kingsley splint or the Major appliance if simple interdental wiring was not indicated.

The use of Kirschner wire fixation as suggested by Brown, of St. Louis, was used in one case and since these data were collected we have used it in several more cases with very satisfactory results.

In six of 212 cases the results were very unsatisfactory. Poor approximation of fragments, non-union, and loss of substance (bone) were some of the presenting problems.

When the fracture was promptly treated, and adequate fixation instituted, complications were less.

CONCLUSIONS

1. Data on 212 cases of fractured jaws are submitted.
2. No attempt is made to evaluate the findings presented.
3. Certain facts not previously reported, associated with fractured jaws are analyzed.
4. The increase in the number of fractured jaws is associated with the increase in the number of automobile accidents.
5. The high percentage of fractures in the female is of interest.

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TREATMENT OF FRACTURES WITH THE HAYNES SPLINT*

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IN the treatment of fractures it is desirable to secure good anatomical reduction of the fragments and to maintain such reduction until healing occurs. With fractures of the shafts of the long bones, this is not always easy. Even if anatomical reduction is secured, the prolonged fixation which is usually necessary leads to muscle atrophy, joint stiffness and circulatory impairment. To clear up these secondary changes sometimes requires a greater period of time than that necessary for bone healing. Especially is this true in fractures of the femur. A fractured femur may show firm union in three or four months yet at the end of one year the patient may still have pain, joint stiffness and disability. This prolonged loss of function could be avoided if joint and muscle exercises could be carried out during the healing period. Such exercises are impossible in usual methods of treatment. Obviously a method which permits such exercises while maintaining firm fixation of bone fragments is highly desirable.

The usual methods of treatment of fractures may be divided into four groups: (1) Continuous traction applied to the skin or directly to the bone; (2) external splinting with plaster, metal or wood; (3) internal fixation through an operative incision, using plates, screws, wire or other material at the site of the fracture. (4) skeletal fixation, using external splints applied to pins inserted into the bone.

In the past five years we have treated over two thousand fractures in this hospital. It is not our purpose to present an analysis of this entire group of cases but to discuss some of our experiences with skeletal fixation in fractures of the long bones.

For several years we treated most fractures of the shaft of the femur by open operation using stout vitallium plates or screws. Excellent anatomical reduction was usually secured. The leg was placed in a Thomas splint suspension apparatus following reduction and mild early exercises were encouraged. Results were better than with most other methods but some degree of stiffness, muscle atrophy and circulatory disturbance was common, and bowing or non-union occasionally developed.

A large number of fractures of the shaft of the tibia were also treated by vitallium plating. The incidence of non-union was definitely increased in spite of more perfect reduction of fragments usually achieved by this method. We have, therefore, watched with considerable interest the recent development of skeletal fixation by means of pins and external splints. After comparing various types of apparatus it appeared to us that the one offering the greatest simplicity, strength and applicability was that devised by Dr. H. H. Haynes.[1] We have had the privilege of using this splint in fifty cases and are pleased with the results so far obtained. The fractures treated involved the following bones:

Femur	14
Tibia	16
Tibia and fibula	16
Ulna and radius	1
Humerus	1
Metacarpal	1

We have also treated one case of tuberculosis of the knee joint by this method of fixation with good results.

The Haynes splint consists of three essential parts: (1) Two or more stout threaded stainless steel pins which have cutting points and are self-tapping; (2) two stainless steel blocks which fit over the pins; (3) two or more connecting bars which are attached to the blocks by friction joints.

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* From the U. S. Marine Hospital, Norfolk, Virginia.

In addition there is a reduction frame which permits all ranges of motion necessary to reduction of fragments. The reduction frame is not essential in all cases but it does increase the ease and precision of reduction. In certain fractures, especially of the femur, it may be impossible to secure satisfactory reduction without this equipment.

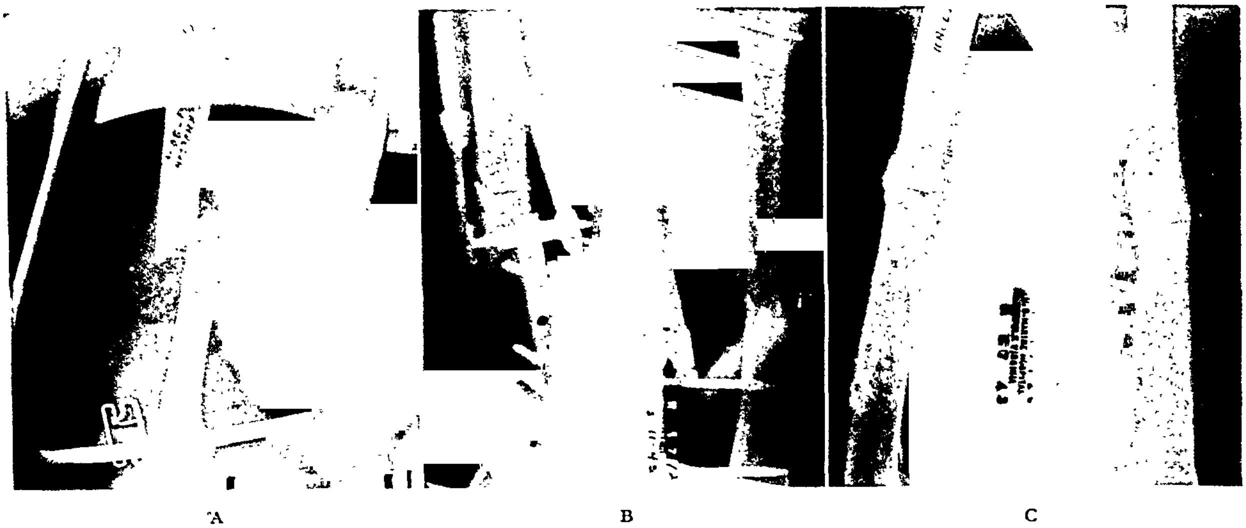
A B C

Fig. 1. A, B, C, fracture, middle third of femur treated by Haynes Splint. Firm healing, splint removed three and one-half months later. Patient left hospital walking without support under four months from date of injury. This was the first fractured femur treated here by this method.

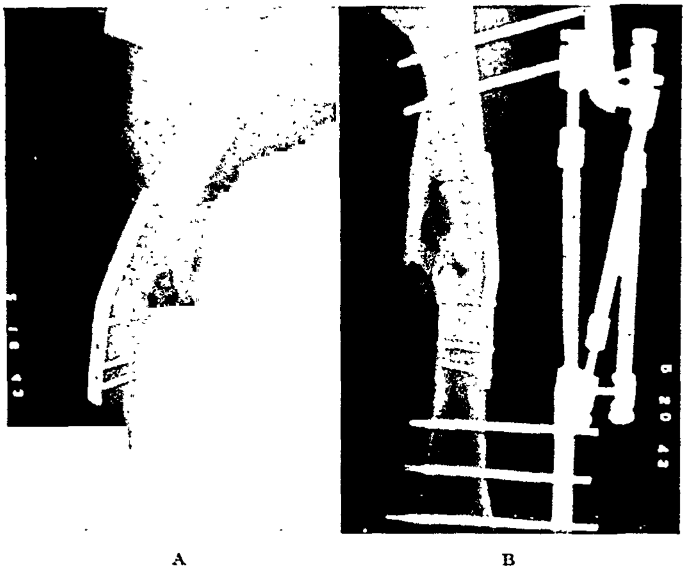
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Fig. 2. A, old fracture of the femur treated with vitallium plating. Four months later the femur is badly bowed. B, Haynes splint applied without removing plate and alignment corrected. A pull upward of two hundred pounds are necessary to correct the alignment but the pins did not bend or loosen.

TECHNIC

The application of the splint is comparatively simple. X-rays should be made and studied carefully for proper placing of the pins. Under aseptic technic a puncture wound is made in the skin, the muscle and fascia spread with forceps, and the pin drilled into the bone by the sense of touch. It is desirable that the pin pass through the proximal cortex, and into, but not through the distal cortex. It is not difficult to drill the bone squarely, and it is essential for maximum strength that the pin be drilled through the center of the shaft. Four pins, two above and two below the fracture site, are commonly used in fractures of the tibia, humerus, ulna or radius. In the adult femur an additional pin is used in both the upper and lower fragments.

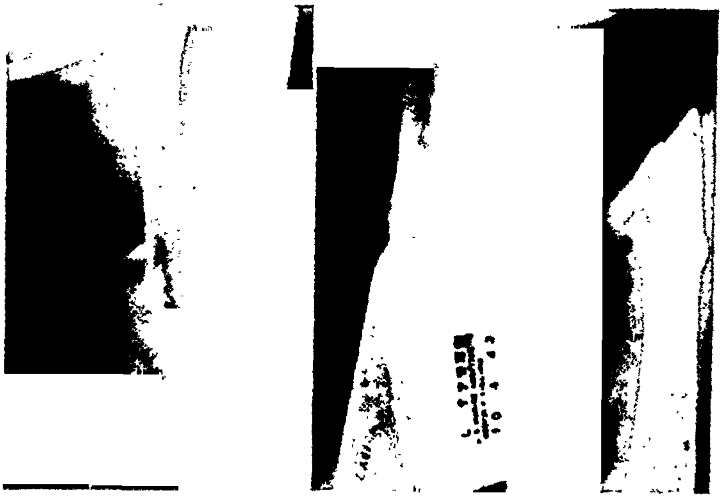

Fig. 3. A, B, fracture of femur treated by Haynes Splint. Although union appeared firm in four months, x-ray showed small amount of callus. Splints were therefore left on seven months to guard against accident. No loosening of pins or infection occurred.

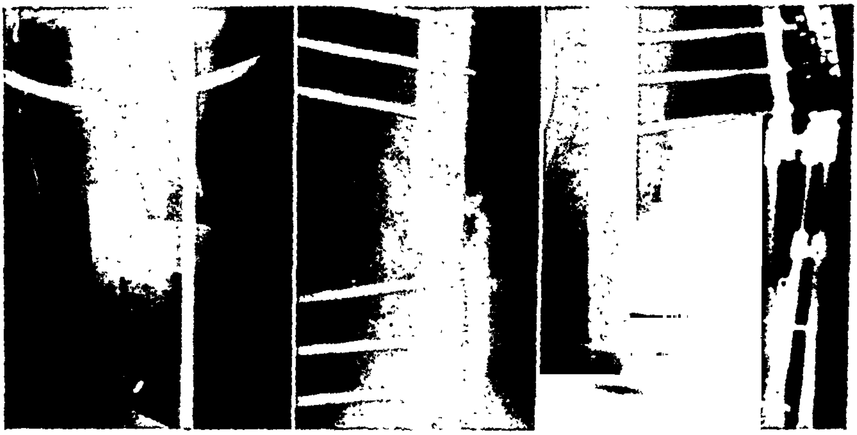

Fig. 4. A, fracture of femur, middle third. B, longitudinal split in both upper and lower fragments not noted on first x-ray renders Haynes splint fixation inadequate. C, open reduction and split fragments held in position while pins are drilled through. Small vitallium plate used for additional security. Patient out of bed in three weeks. The splint was removed in three and one-half months at which time firm union was present.

After the pins are inserted and the blocks are placed over the pins, dressings are applied and sterile technic may be dispensed with. Reduction is carried out under the fluoroscope. The pins will withstand a tremendous strain without becoming loosened or bending. This is well demonstrated in Figure 2. After accurate reduction and while the reduction frame is still in position, the connecting bars are fastened securely. The reduction device is then removed. No fixation other than the splint is required when the patient is returned to bed. Active motion is permitted from the beginning.

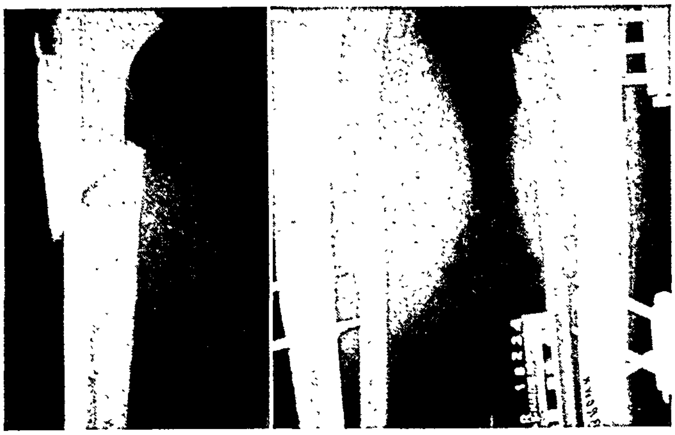

Fig. 5. A, fracture, upper third, tibia and fibula treated with Haynes splint. B, approximately three months later with firm union and no joint stiffness; very little muscle atrophy. The splints were removed immediately after the above x-rays.

Some of the patients in this group are still undergoing treatment but there have been sufficient recoveries to warrant certain conclusions:

We believe that the healing time is definitely decreased by this method. The patients are more comfortable since they can be up and about instead of being confined to bed. Joint motion is usually possible immediately after reduction. Partial weight-bearing on crutches can be started early in almost all cases. Much harm can be done by creating an impression that patients can walk without support immediately after reduction of a fractured femur or even a tibia. The Haynes splint in our opinion provides the stoutest support now available for skeletal fixation of fractured long bones, but we do believe that a certain amount of caution should be reserved in its use.

Undoubtedly many patients could be up walking the day following reduction, but the same might be said of a patient who had undergone a laparotomy. We have practically always had to restrict patients rather than urge them to greater activity.

Nursing care has been cut to a minimum on these patients since they are not long confined to bed, and can take care of themselves with but little help. Their mental outlook is usually good. The profound depression which is so often seen in patients long confined to bed is strikingly absent.

Due to the continuous active use of the limb muscle atrophy occurs only to a very limited degree. Circulatory impairment is slight or absent and there is very little joint stiffness.

The only discomfort of any importance is that caused by skin pull on the pins. This pull is not appreciable in the tibial region but is sometimes troublesome in the thigh. It can be controlled by lessening the patient's activity. The pull of skin and musculotendinous structures against the pins in the thigh at times also cause "pin seepage." This is an irritative rather than an infectious phenomenon and appears to have little clinical importance. The wounds heal promptly when the pins are removed.

There is one point which we would like to stress. During the healing period some absorption takes place in the bone at the fracture site. This factor probably accounts for the increased incidence of non-union where internal plating is used. The same thing may occur with skeletal fixation unless guarded against. The sliding bars on the Haynes splint can be loosened without changing the alignment of the bone. These bars should be loosened about every ten to fourteen days and the bones slightly impacted. Instead of delayed healing or non-union, more rapid healing will occur than with ordinary methods of treatment, if this point is observed.

In presenting this report based on a limited number of cases, we trust that our enthusiasm has not warped our judgment. It is our carefully considered opinion at this time that the Haynes splint is a valuable contribution to the treatment of fractures of the long bones and that through its proper use healing time is lessened and function improved.

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Dislocations should be reduced immediately, as delay increases the swelling and the continuous pressure of the displaced bone may cause serious damage to the soft parts. In most instances general anesthesia is necessary for muscular relation. For dislocations produced by leverage the displaced bone must be replaced also by leverage, returning through the rupture which it produced in the joint capsule.

From "Fractures and Dislocations for Practitioners," by Edwin O. Geckeler (The Williams & Wilkins Company).

THE USE OF CURARE IN ANESTHESIOLOGY*

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ONE of the most interesting new developments in anesthesiology is the use of curare for obtaining the necessary degree of relaxation. What makes this application of curare especially significant is the fact that this alkoloid is a non-anesthetic and a non-hypnotic drug, thus providing us with a totally different physiological mechanism involved in such an action. Though known since the time of Sir Walter Raleigh and fully described by Claude Bernard in 1865, curare within the last few years only has undergone a transition from an experimental drug of a physiological laboratory to a bona fide clinical agent for the treatment of diseases characterized by convulsive states or by some neuromuscular syndromes such as spastic paraplegia, athetosis and advanced Parkinsonism. The main reason for such a delayed clinical application has been the difficulty, only recently solved, of obtaining a reliable drug of a constant physiological action. Its use in anesthesia is the logical outcome of its application in the convulsive shock therapy of schizophrenia to produce generalized muscular flaccidity in order to protect patients from traumatic fractures.

GENERAL COMMENTS

A proper relaxation is the fundamental requirement for surgery, especially abdominal. Until the appearance of curare it could be achieved only by the depression of the activities of the central nervous system, as is observed in general anesthesia, or by an interference with the nerve conductivity as seen in local analgesia including the subarachnoid block. These methods, though universally employed, have some innate dangers, disadvantages and limitations—a perfect physiological anesthesia as yet does not exist—particularly when in this quest for relaxation the biological bounds of human tolerance for anesthesia are being stretched to the limit. In general anesthesia this usually leads to a profound depression of not only the central nervous system, but also an equal depression of the respiratory and circulatory mechanisms, hypoxia, degenerative changes of parenchymatous organs, loss of electrolytes and so forth, all in a direct proportion to the depth and the duration of anesthesia. Even a local anesthesia has its shortcomings: it is not always applicable, the desired effects even in skilled hands are not always obtainable, not counting the danger from an occasionally encountered susceptibility toward the drug itself or an excessive amount of it. As to spinal analgesia, though capable of inducing an extreme relaxation, this form of local anesthesia has its drawbacks, too, such as a limited time of its duration, an always present danger of an anaphylactic reaction and the inadvisability of this type of analgesia for the aged, especially in the presence of shock.

In addition to these fundamental limitations of present day anesthetic procedures and methods, an anesthetist quite often is faced with certain incidental problems: the anesthesia may be poorly borne by the patient or poorly administered; he may have a patient in whom only a very brief but an extreme relaxation is in order such as is needed in an acute intestinal obstruction or in a difficult bronchoscopy; or a prompt relaxation is imperative for the closure of peritoneum in a patient with a vanishing spinal block. In such cases our standard methods may prove to be inadequate.

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Curare with its peripheral action on the skeletal muscles only, with its prompt ability to produce perfect relaxation without any direct depression of the central nervous system, and the simplicity of its administration certainly offers us a new weapon to overcome certain difficulties that may arise during anesthesia.

PHARMACOLOGY AND PHYSIOLOGY

Curare is obtained by the brewing of stems, roots, leaves and bark of several species of strychnoes. Its main claim to fame and popularity lies in the fact the South American Indians of the Amazon River and Ecuador have used it as an arrow poison. The active principles of curare are different but related to each other alkaloids of which curarine and tubocurarine are mainly responsible for its specific action. Their chemical composition still remains unknown; in many ways it is related to strychnine. The crude curare is a resinoid mass of a brownish black color, soluble in cold water and diluted alcohol. There are many varieties of curare of which three are the most important, namely, the tubocurare, the calabash curare and the pot curare, deriving their names from the type of the container in which they are sold: bamboo tubes, gourds and earthenware jars. The tubocurare contains two alkaloids: tubocurarine and curine; the calabash curare consists mostly of one alkaloid curarine, while the pot curare contains three alkaloids of which protocurine is the most important. For clinical use curarine and tubocurarine only are suitable; they are very similar in their physiological action and are free, at least in their therapeutic doses, from any damaging effect on the heart and lungs. These two alkaloids are the main source of intocostrin, the commercial preparation of curare which is at the present time on the market. It is a physiologically assayed preparation of a uniform strength and action that comes in a 5 cc. bottle containing 100 mg. of standard drug.

The site of curare's action primarily are the motor end plates or neuromuscular junctions, which make it a peripherally acting agent. Curare does not paralyze either a muscle or its nerve, but exerts a specific action on the chronaxies of the skeletal muscles without affecting the corresponding nerve chronaxies, thus inducing the so-called state of heterochronism. Its blocking of transmission of impulses in autonomic ganglia is not as marked, and under ordinary conditions death from a paralysis of the respiratory muscles takes place before the ganglionic action has time to develop. The muscles of the fingers, toes, eyes, and ears are affected first, then those of limbs, neck and trunk and finally those of the diaphragm. It has no direct action on the heart and consciousness and sensibility are not affected. Curare has no anesthetic properties whatsoever.

The most effective route of administration is the intravenous injection of the drug; the effects of such an administration are manifested very promptly, in one or two minutes. First, there is a feeling of heaviness of the eye lids followed by bilateral ptosis, nistagmus, strabismus and diplopia. The neck muscles are affected next; facial expression is quickly lost, speech becomes difficult due to the flaccidity of the throat and jaw muscles. The spinal muscles are affected next after which a complete paralysis of the arms and legs takes place. The skeletal muscles are affected next practically in the same order as it is observed in progressive myastenia gravis. The choline esthers, physostigmine and prostigmine are the pharmacological antidotes and antagonists to curare due to their stimulating effect on ganglia and skeletal muscles. Gastrointestinal absorbtion of curare is very insignificant in view of a more rapid degree of detoxication than that of absorption. Inasmuch as curare is partially destroyed by the liver and the remainder is eliminated unchanged by the kidneys, a non-impaired function of these organs is essential for the safe administration of this drug. The arrest in respiration observed after a heavy dose of curare is of a transient character and of no particular danger, at least to the anesthetist, to whom a respiratory arrest such as is obtained in so-called "apnea technic" or "controlled respiration" is not an accident but merely a method for inducing the proper degree of relaxation.

METHOD OF ADMINISTRATION

In view of the unpleasant subjective manifestation following the use of curare, a light general anesthesia, just sufficient to abolish pain sensitivity and consciousness, must be used in conjunction with its administration. Cyclopropane appears to be the most suitable agent. There are two methods for the clinical use of curare: Griffith with his extensive experience with cyclopropane uses a relatively deep cyclopropane anesthesia and one single injection of 100 mg. of intocostrin. Cullen finds such a single injection insufficient, especially if the length of operation exceeds half an hour, and is using additional injections of smaller amounts of curare throughout the operation.

From our rather limited experience we believe that Cullen's method gives a better result. Our technic for the use of curare is as follows: We begin our general anesthesia with cyclopropane and as soon as the first plane of surgical anesthesia has been established the patient is wheeled into the operating room. Simultaneously with the preparation of the operative field one of the patient's arms is exposed and a needle attached to a syringe containing 5 cc. of intocostrin is inserted into the vein. As soon as the skin incision is made 3 cc. of intocostrin are rapidly injected; if the patient is not relaxed by the time the peritoneum is being opened, the remaining 2 cc. of intocostrin are added. As a rule these 100 mg. of curare produce an excellent relaxation usually lasting fifteen to twenty minutes, after which additional doses of 1 cc. of intocostrin are given from time to time depending upon the degree of relaxation needed. Except for the change in the respiration, intocostrin produces practically no systemic effect, the blood pressure and pulse remaining unchanged throughout the operation. One has to be cautious with the secondary injections of curare because of its cumulative action. In one of our cases a rapid injection of 2 cc. of intocostrin near completion of an operation resulted in a severe respiratory depression.

One may ask, what are the advantages of curare in comparison with other rapidly acting agents also capable of producing a complete relaxation, such as the intravenous administration of pentothal sodium. We believe that curare is a relatively safer drug. While with barbiturates the respiratory depression is of a central character and is due to the direct action on the brain, the arrest in respiration that may follow the use of curare is of a secondary character as it is only a sequel to the paralysis of the diaphragm. To combat the latter is much easier than that which is due to a direct central paralysis of respiration.

SUMMARY AND CONCLUSIONS

1. We believe that the use of curare has a definite place in anesthesiology, especially in cases in which a profound but brief relaxation is indicated or in which there are difficulties in obtaining the desirable degree of relaxation.

2. In view of the unpleasant subjective symptoms accompanying the use of this drug, we believe it must be used in conjunction with a light general anesthesia.

3. Unquestionably, curare shall have only a limited application in the field of anesthesiology; but under certain conditions it should prove to be an extremely useful and even a life-saving drug.

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Case Reports

DOUBLE KIDNEY AS A SOURCE OF IMPAIRED DYNAMISM*

ITS SURGICAL TREATMENT BY HEMINEPHRECTOMY

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OF all anomalies of the upper urinary tract, double kidney is the most common. While many different types of this anomaly occur, the one most frequently observed consists of the presence of one large kidney with two independent renal pelves and two ureters. These double ureters may be united at any level, from the lower pole of the kidney to the bladder, or they may open separately into the bladder in the region of the trigone. Sometimes the second ureter is found ectopic, opening at some point outside of the urinary bladder, causing urinary incontinence, particularly in the female, and as a rule producing hydroureter and hydronephrosis in the corresponding half of the double organ. It is also commonly observed that the ectopic ureter corresponds to the upper pole of the double kidney. This duplex condition, when associated with urinary incontinence, always demands surgical intervention for correction of the surgical malformation.[1]

While it is freely admitted that not all double kidneys give rise to symptoms or pathologic conditions, it is a fact that clinically and at postmortem more than half the cases of this congenital malformation are found associated with one type or another of surgical pathologic lesions, some of which demand relief by surgical intervention.

The embryonic development and anatomic varieties of double kidney and ureter have been thoroughly discussed in the literature and will not be gone into at this time.[2]

Although it has been said that three kidneys might be expected to function better than two, clinical experience has shown that such is not the case; and that the third kidney is in most instances an intruder, encroaching upon the rights of the two legitimate kidneys. In other words, it now appears that the supernumerary upper or lower renal pelvis of the double organ may be the source of a pathologic process, discovered urologically or urographically, and that it is present more often than was ever suspected prior to the urographic era.

It has been observed clinically and anatomopathologically that in the double kidney with complete bifurcation of the two ureters there is as a rule a crossing or even a double crossing of these two ureters somewhere between the kidney and the bladder and that the ureter corresponding to the upper renal pelvis is invariably the one in ectopia. Since there is always in these cases a certain degree of nephroptosis, it can be readily understood that the double ureters in crossing make pressure upon one another, and thus interfere with the drainage of the double kidney from which they issue. As a result *the dynamism of these crossed ureters becomes impaired;* their rhythmic contractions are disturbed; the time of emptying is retarded. Owing to the intricate nerve connections between the kidney and ureter on the one hand

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* Read before the Section of Genito-Urinary Surgery, New York Academy of Medicine, May 17, 1944.

and the chief ganglia of the abdomen on the other, the crises of pain arising in an overfilled ureter and renal pelvis are readily transmitted to the abdominal cavity, where they may give rise to indefinite abdominal pain with nausea and vomiting, frequently mistaken for appendicitis, especially if the double kidney and ureter are on the right side. These abdominal or gastrointestinal symptoms may completely divert the attention from a double kidney as the possible underlying cause of the surgical syndrome, and may thus mislead in diagnosis.

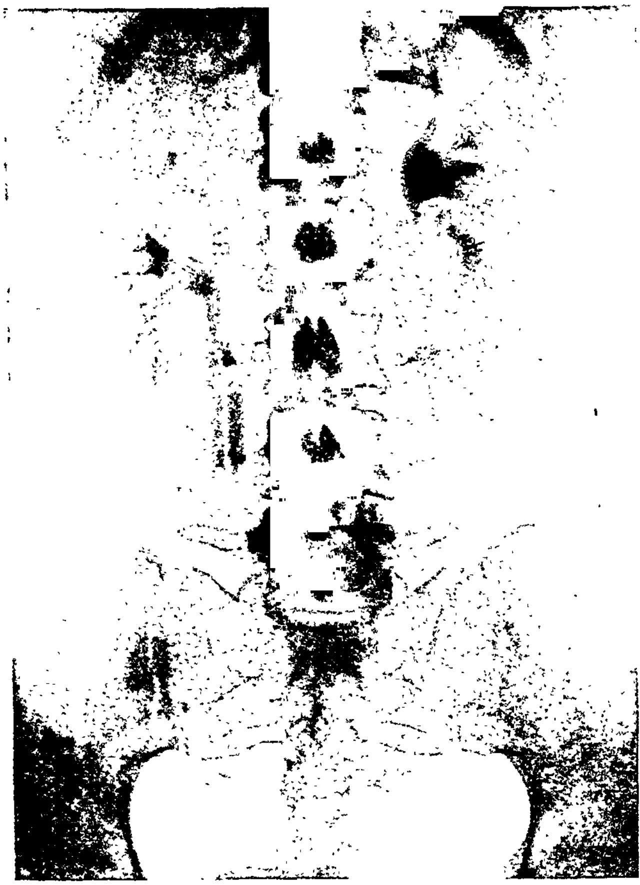

Fig. 1. Intravenous urogram revealing the presence of a right double kidney with double pelves and double ureters. The left kidney pelvis is well delineated and appears to be within normal limits. The double ureters of the right side are dilated, demonstrating urinary stasis and dynamic dysfunction.

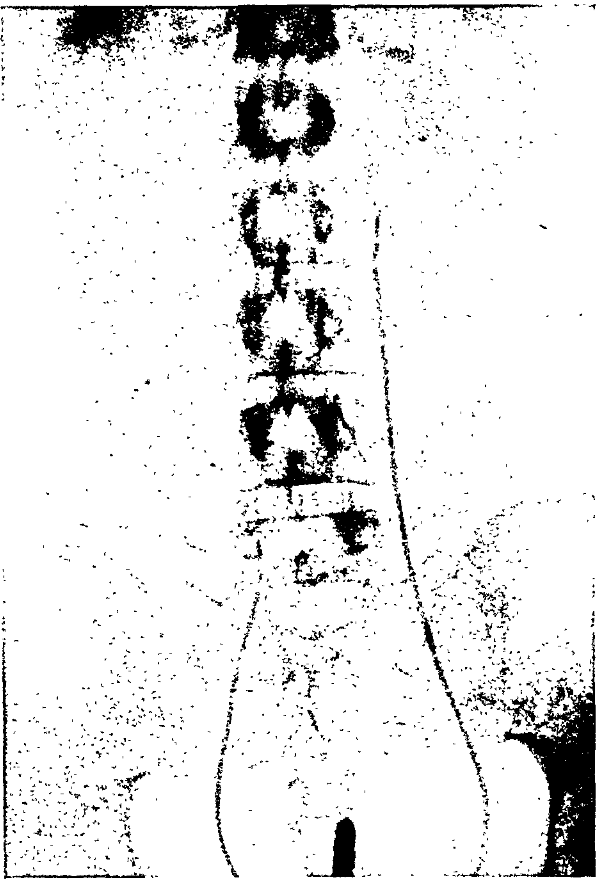

Fig. 2. Plain roentgenogram showing ureteral catheters and instrument in position. There is no shadow indicative of stone anywhere in the urinary tract. The right ureteral catheter meets obstruction at the level of the last lumbar vertebra. The shadow of the right kidney is enlarged and low in position.

Admittedly, conservative operation for relief of associated disorders in one-half of a double kidney has been performed even prior to the urographic era, but only in cases in which the diagnosis was made at operation. Since urography has been routinely used, conservatism in renal surgery has been steadily on the increase. However, it is to be noted that conservative surgery deliberately undertaken for the correction of the *impaired dynamism and faulty mechanics* of the double kidney has been seldom if ever carried out. Usually the double kidney has been left to go on its way, as a harmless malformation of no surgical or pathologic interest, unless a gross pathologic lesion is visualized in the urogram.

The main purpose of this presentation is, accordingly, to discuss this very modern idea of the importance of the *orthopedic surgical correction of the double kidney, with a sole view to its restoration to normal function.*

It is not uncommon to see a patient with a history of abdominal pain who has been operated upon for so-called chronic appendicitis without relief of symptoms, and in whom, after urologic and urographic examination, a double kidney with double ureter in one or both sides of the body is discovered, with evidence of urinary stasis, marked pyelectasis, calyectasis and retardation of the dynamic physiologic emptying time of one or both pelves of the double organ. This double kidney then proves to be the underlying cause of the entire syndrome, and it obviously demands surgical intervention for the correction of the malformation *per se*, with a view to the permanent relief of symptoms for which it is chiefly responsible.

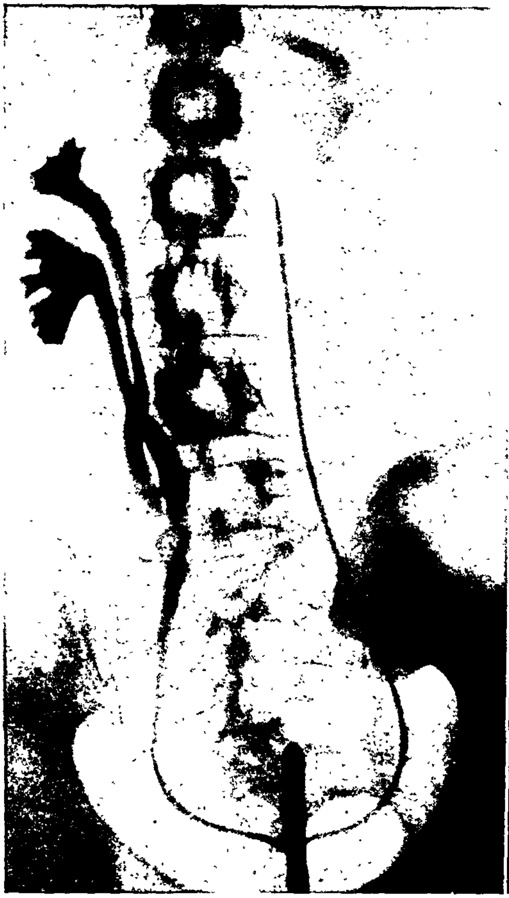

FIG. 3. Right retrograde pyelo-ureterogram disclosing beautifully the presence of a right double kidney with double pelves and double ureters. The double ureters appear to be united into one at the level of the promontory of the sacrum. They are seen to be dilated, revealing urinary stasis and evidence of pyelitis and pyelonehpritis.

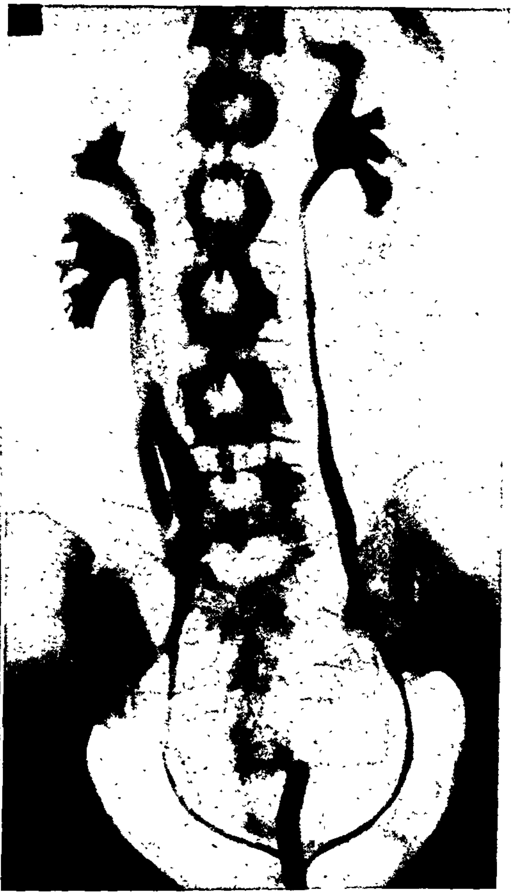

FIG. 4. Bilateral retrograde pyelo-ureterogram. The right double kidney with double pelves and double ureters is obviously dilated, disclosing urinary stasis and dynamic dysfunction. The double ureters are crossed, and there seems to be a narrowing at the point of their union. The left kidney pelvis and left ureter are well delineated and within normal limits.

Heminephrectomy, or partial resection of the kidney, has been performed in many congenital malformations of the kidney, notably in the horseshoe kidney and other types of ectopic fused kidney, and even in a single normal kidney with associated pathology in the upper or lower calyx in which double polar resection can be carried out. However, it is my intention here to discuss only the applicability of this conservative operation to the orthopedic restoration of the dynamism and correct function of the double kidney with double ureter. I am referring to the group of cases in which the presence of the double organ has caused persistent crises of indefinite abdominal pain, without visualization of gross pathologic conditions, cases in which many errors of diagnosis have been made, including those in which an unavailing appendectomy has already been performed, and in which the patient, after being properly diagnosed urologically and urographically, has at long last been submitted to an operation planned and successfully carried out solely for such functional restoration, with conservation of renal tissue, achieving permanent cure with disappearance of all symptoms.

To this end I am reporting an illustrative case with completely satisfactory results, and I am presenting at the same time the technic that I have successfully employed.

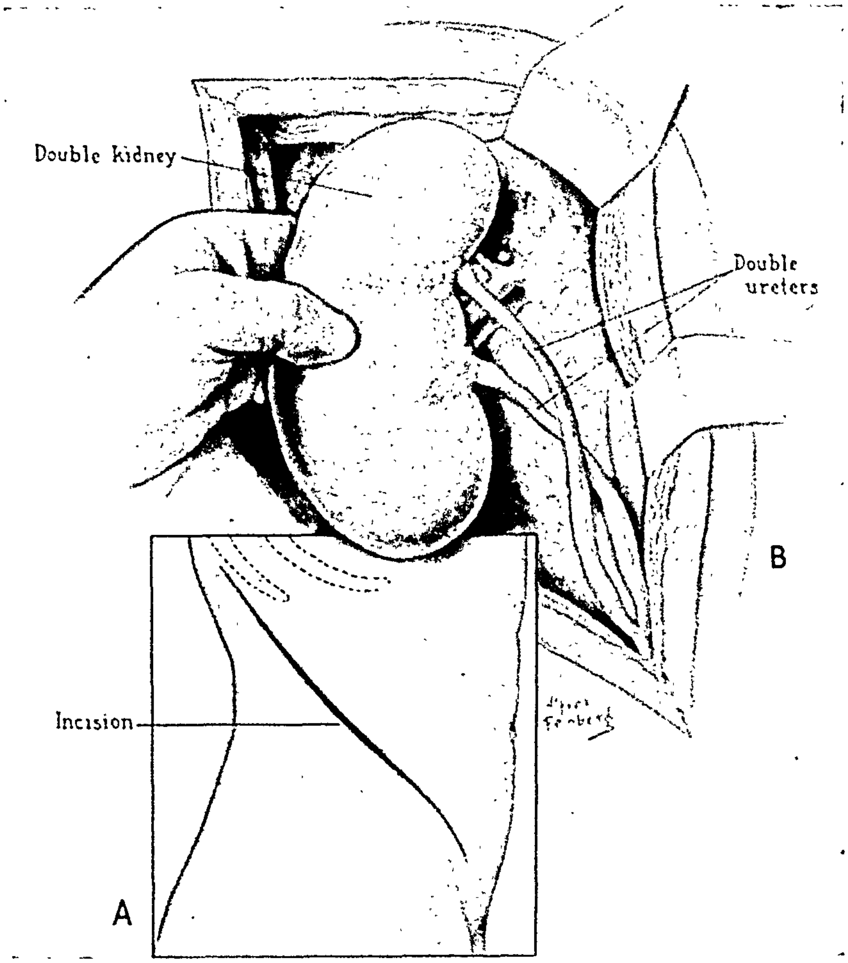

Fig. 5. Operative technic for heminephrectomy in a double kidney: A, drawing of oblique lumbo-abdominal incision; B, the double kidney and double ureters are readily exposed and drawn out of the wound. The double ureters are seen dilated, crossed and united into one at the level of the sacro-iliac synchrondrosis.

ILLUSTRATIVE CASE OF A RIGHT DOUBLE KIDNEY WITH DOUBLE URETER CAUSING INDEFINITE ABDOMINAL PAIN AND URINARY DISTURBANCES FROM BIRTH—CURED BY HEMINEPHRECTOMY

Miss F. T., twenty-four years of age, an office secretary, was referred to me October 7, 1941, complaining of pain in the right lumbar region, frequency of urination day and night, and marked dysuria. She gave a history of having had an attack of pain on the right side of the abdomen for which she was operated upon about a year ago and an appendectomy carried out, but without relief of symptoms.

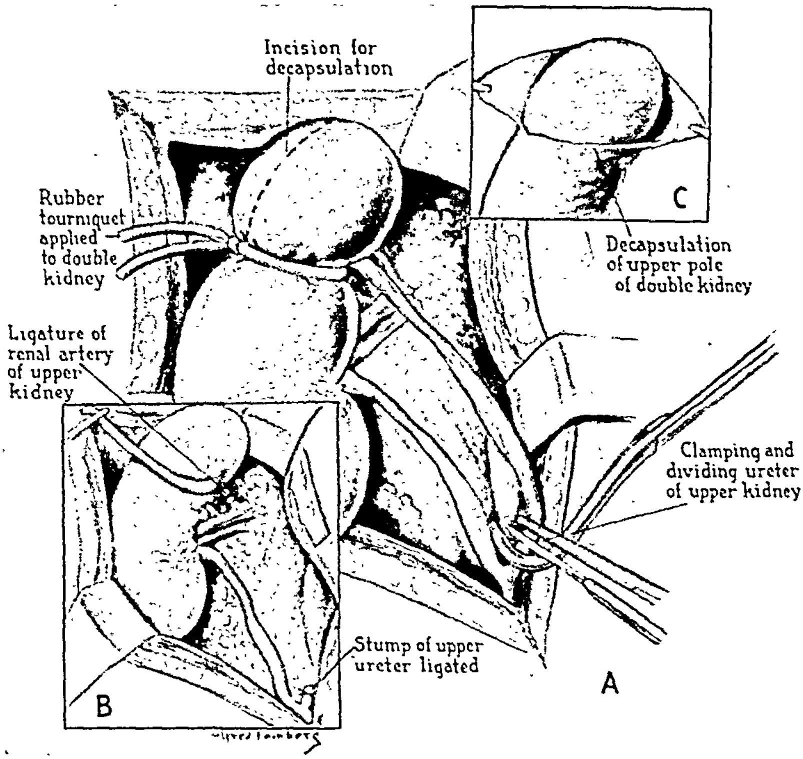
Incision for decapsulation
Rubber tourniquet applied to double kidney
Ligature of renal artery of upper kidney
C
Decapsulation of upper pole of double kidney
Clamping and dividing ureter of upper kidney
Stump of upper ureter ligated
A
B

Fig. 6. Operative technic for heminephrectomy in a double kidney: a, the ureter corresponding to the upper kidney pelvis is doubly clamped at its junction with the ureter corresponding to the lower kidney pelvis, and divided and ligated. A rubber tourniquet is applied around the line of demarcation between the two parts of the double kidney to serve as a landmark for their separation and for better hemostasis. b, the stump of the divided upper ureter is dissected free in order to visualize the pedicle of the kidney and the blood supply of the upper pole of the double organ. The retropyelic renal artery of the upper kidney, which was here a branch of the main renal artery, is exposed, clamped, excised and ligated. c, the capsule of the upper pole is incised longitudinally, freely separated and retracted to expose the renal parenchyma.

Attacks of this kind were repeated on several occasions after the appendectomy operation, and incapacitated her for work. About three weeks previous to coming to the office she awoke with another such attack which kept her in bed for several weeks, during which time she stated that she had been taking sulfa drugs without relief of symptoms. From her parents I then learned that when the child was three years old she had begun to have these attacks off and on, and had suffered frequently ever since with gas pains, chronic constipation and marked abdominal distention. The voided specimen of urine was cloudy and contained pus and traces of albumen.

On physical examination the abdomen was distended, and the scar of the appendectomy operation in the lower median line of the abdomen was clearly observed. The right kidney was enlarged on palpation, low in position, tender and easily palpable. The left kidney could not be palpated. Examination of the external genitals was normal. Rectal examination was negative. The impression was of right nephroptosis with definite disturbance in the right kidney, for which a complete urologic and urographic examination was carried out.

Intravenous urograms disclosed the presence of a right double kidney with double ureters, with pyelitis and pyelonephritis and evidence of pyelectasis, calyectasis and lack of drainage. In fact the ninety-minute film disclosed marked retardation of the emptying time of the double kidney and double ureters. (Fig. 1.) The left kidney was clearly visualized and within normal limits. In view of these findings retrograde studies were carried out, including cystoscopy, catheterization of ureters, differential renal functional tests and bilateral retrograde pyelo-ureterograms to determine the separate function of the three kidneys, and also to discover whether the two ureters of the fused organ opened normally into the bladder or were united outside of the bladder. A specimen was sent to the laboratory for culture, urea estimation and microscopic examination.

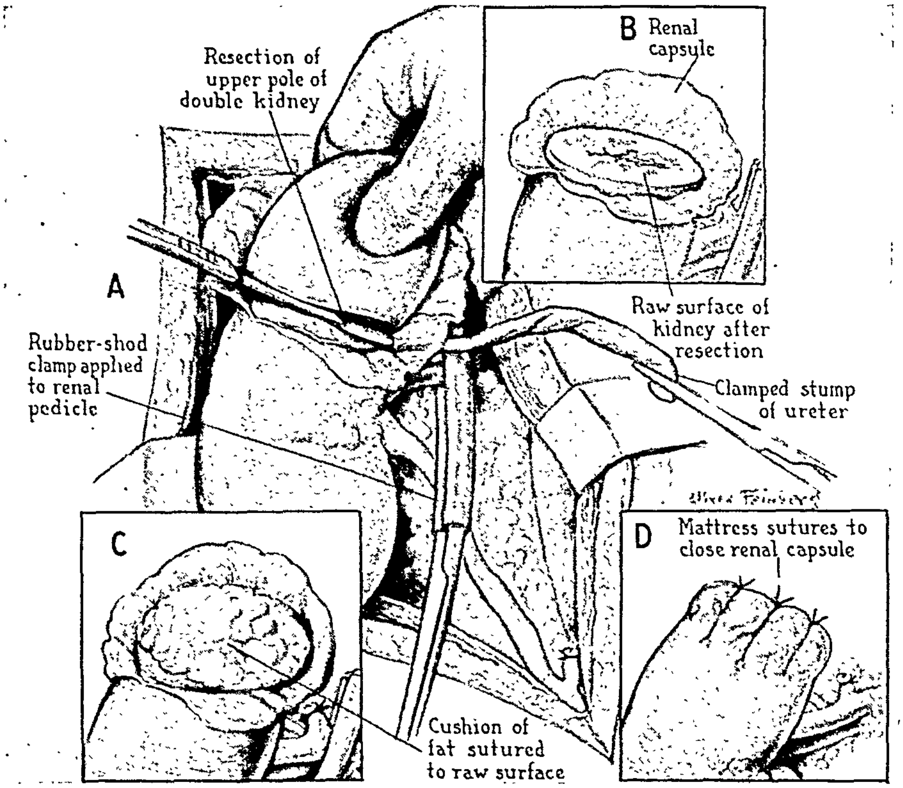
Resection of upper pole of double kidney
B Renal capsule
A
Rubber-shod clamp applied to renal pedicle
Raw surface of kidney after resection
Clamped stump of ureter
C
D Mattress sutures to close renal capsule
Cushion of fat sutured to raw surface

Fig. 7. Operative technic for heminephrectomy in a double kidney: A, the rubber tourniquet has been replaced by a rubber-shod clamp applied to the pedicle for better anatomic exposure and complete hemostasis. The upper pole of the decapsulated double kidney is resected with its entire upper ureter. B, the raw cut surface of the kidney after resection is seen with the retracted renal capsule. C, a cushion of fat is transplanted to cover the raw surface of the kidney to prevent bleeding and is fixed in position with plain catgut sutures. D, the capsule of the remaining portion of the resected double kidney, which is already covered with the cushion of fat, is drawn together and closed with mattress sutures.

The retrograde studies, carried out on October 16th, revealed beautifully in the film of the right pyelo-ureterogram the presence of a double kidney with double renal pelvis and ureters (Figs. 3 and 4), the latter crossing each other at the level of the fourth lumbar vertebra and interfering with the dynamism and emptying time of both right renal pelves. The two ureters were united at the level of the right sacro-iliac synchondrosis to continue as a single ureter which opened normally into the bladder. There was also mechanical obstruction at the point of their union, more marked in the pyelograms taken in the erect posture, thereby revealing also a certain degree of nephroptosis. There was dilatation of the calyces and both pelves and ureters throughout, indicating the presence of urinary stasis, pyelitis, pyelonephritis and marked ureterectasis. The upper pelvis of the double kidney was T-shaped, while the lower one appeared to be that of a fairly normal kidney pelvis. The two right renal pelves were definitely separated from one another and were clearly without intercommunication.

The impression, therefore, was that of a double kidney on the right side with duplication of renal pelves and ureters, with evidence of marked urinary stasis, nephroptosis, lack of drainage and obstruction at the union of the two ureters, all these combining to cause dynamic dysfunction, responsible for the entire syndrome.

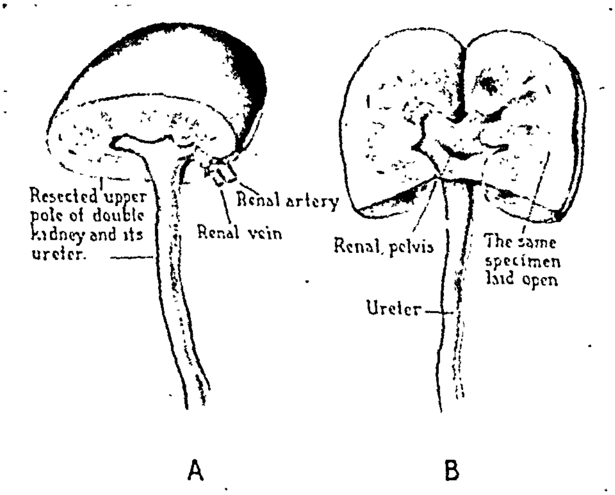
Resected upper pole of double kidney and its ureter.
Renal artery
Renal vein
Renal pelvis
The same specimen laid open
Ureter
A
B

Fig. 8. Drawing from the postoperative specimen removed at operation: A, the heminephrectomized upper pole of the double kidney is shown with its pelvis and ureter, and its corresponding renal artery and renal vein. B, the same specimen laid open, showing a dilated renal pelvis and ureter, and revealing normal parenchyma with pyelitis and pyelonephritis.

The patient was accordingly admitted to the Murray Hill Hospital October 16, 1941, for operation on a double kidney. It was explained to her that the lack of dynamism and the faulty drainage were the cause of all her troubles and that these no doubt would continue to cause a gastro-enterorenal syndrome, which could be permanently cured only by carrying out a heminephro-ureterectomy under general anesthesia.

Operation was performed on October 18, 1941, under cyclopropane anesthesia. With the patient lying on her left side, an oblique incision about 15 inches long was made running obliquely downward from the right costovertebral angle through McBurney's point to the midline. (Fig. 5A.) Fascia and muscle were cut and retracted; bleeding points were clamped and ligated; the peritoneum was retracted. The fatty capsule of the kidney was clamped and opened from behind; the kidney, which was somewhat adherent, was freely exposed and liberated from its surrounding attachments by blunt dissection. Its two ureters, running to the two separate kidney pelves, were identified and exposed down to the point where they united at the level of the sacro-iliac synchondrosis. (Fig. 5B.) The ureter corresponding to the upper kidney pelvis was clamped at its junction with the ureter corresponding to the lower pelvis. (Fig. 6A.) The upper ureter was excised, its stump cauterized with carbolic acid and alcohol, and then ligated with chromic catgut. The double kidney was then properly exposed out of the wound and the pedicle dissected from behind to identify the blood supply of the organ. By retracting the cut ureter of the upper kidney pelvis and by blunt dissection, the retropyelic renal artery of the upper kidney, which was a branch of the main renal artery, was exposed, clamped, excised and ligated. (Fig. 6B.) A rubber-shod clamp was applied to the pedicle of the kidney to prevent bleeding and to obtain better exposure. A soft rubber catheter was tied around the kidney as a tourniquet in between the two renal pelves and about the line of demarcation between the two parts of the double kidney. (Fig. 6A.) The capsule of the upper pole was incised and dissected from its attachment to the kidney, thus accomplishing its decapsulation. (Fig. 6C.) The upper kidney was then excised and removed, with its attached ureter, leaving the retracted capsule. (Fig. 7A and B.) There was practically no bleeding, but a piece of fat was transplanted to the raw surface and held in place by several transrenal sutures of catgut; this raw surface with its covering of fat was then covered over with the renal capsule, which was closed with mattress sutures. (Fig. 7c and d.) The rubber-shod clamp on the pedicle was removed, and again there was no bleeding, hemostasis being complete. Nephropexy of the remaining organ was then carried out by simple fixation with chromic catgut sutures between the levels of the eleventh and twelfth ribs, suspending the organ in its normal position. This procedure puts the ureter in a perfectly straight line and secures good drainage. The kidney was further anchored by placing another suture in the capsule of the lower pole, fixing it to the quadratus lumbaris muscle to complete the nephropexy. Gerota's fatty capsule was closed from below, right up to the quadratus lumbaris muscle and over the kidney up to the costovertebral angle, as a further reinforcement of the nephropexy. A cigaret drain was placed in the upper angle of the wound; the wound was closed in layers by chromic catgut sutures, first the muscles, then the fascia, and finally the skin with silkworm gut sutures.

Postoperatively the diagnosis was double kidneys with double ureters on the right side. The two ureters were doubly crossed, and there was definite stricture at the point where they united, interfering with normal drainage, with evidence of dilatation of both ureters, acute pyelitis and pyelonephritis. The specimen consisted of the upper pole of the resected double kidney with its dilated pelvis and ureter. (Fig. 8a and b.)

The patient had an uneventful convalescence and left the hospital twenty-five days after the operation with the wound completely healed and free from symptoms.

Three weeks after operation, in order to check up the results, I carried out complete studies, including cystoscopy, catheterization of both ureters, differential functional tests and bilateral retrograde pyelo-ureterograms. The results of these various tests proved that the remaining portion of the right double kidney, which had been heminephrectomized, was functionally and urographically perfectly normal. (Figs. 9, 10 and 11.) In fact the function of this kidney was better than that of the left kidney with reference to phenolsulphonephthalein and urea excretion, thus indicating that the remaining half of the double right kidney will be sufficient to sustain life.

COMMENT

I am reporting this case because it illustrates so beautifully the rôle that the anomalous double kidney can play in the causation of surgical disorder in the upper urinary tract. It serves also to show how easily the general surgeon can overlook the true cause of symptoms that masquerade as acute conditions of the abdomen, when in reality they originate in the urinary system.

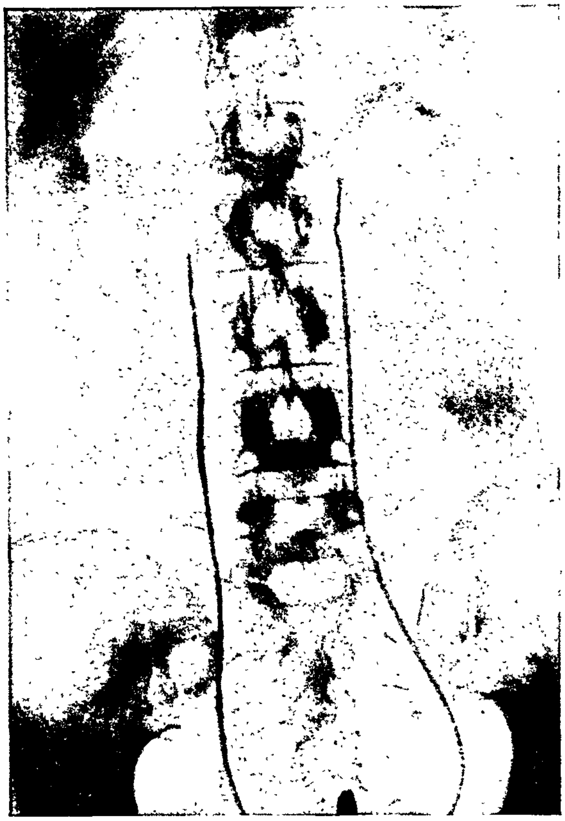

Fig. 9. Plain roentgenogram of the same patient taken three weeks after heminephrectomy of the right double kidney. Note the correct position of the two ureteral catheters and especially the one in the right ureter, which before operation could not be catheterized.

Here was a girl who had suffered from birth with intermittent attacks of indefinite abdominal pain, often hovering about McBurney's point, so that the case was easily mistaken for appendicitis and an unnecessary appendectomy performed without relief of symptoms. When the true cause was discovered in a double kidney with double ureter, with congenital dysfunction leading to chronic urinary stasis, it was obvious that treatment must be addressed to the surgical correction of the malformation. As soon as this was done, relief of symptoms promptly followed, with complete restoration of normal function and disappearance of symptoms.

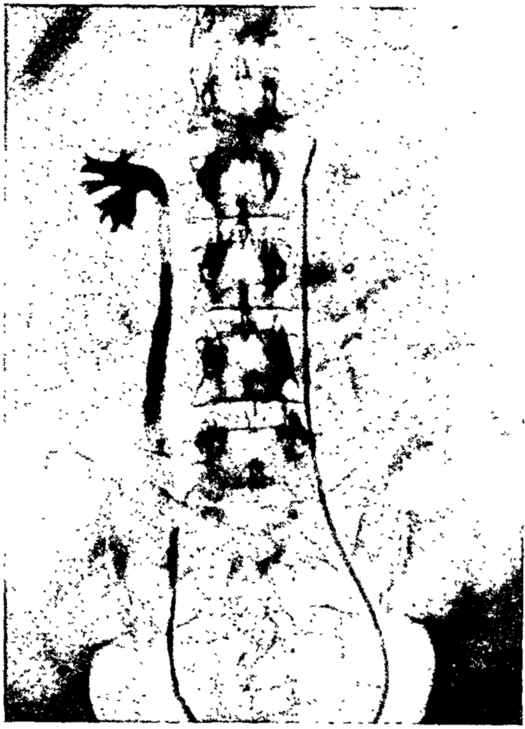

FIG. 10. Right retrograde pyelo-ureterogram taken three weeks after right heminephro-ureterectomy in a double kidney followed by nephropexy. Note that there is now only one renal pelvis, which is the lower pole of the resected double kidney. The major and minor calyces are well delineated and appear normal. The ureterogram discloses a perfect right ureter with good drainage. The kidney has been restored to its normal position and function.

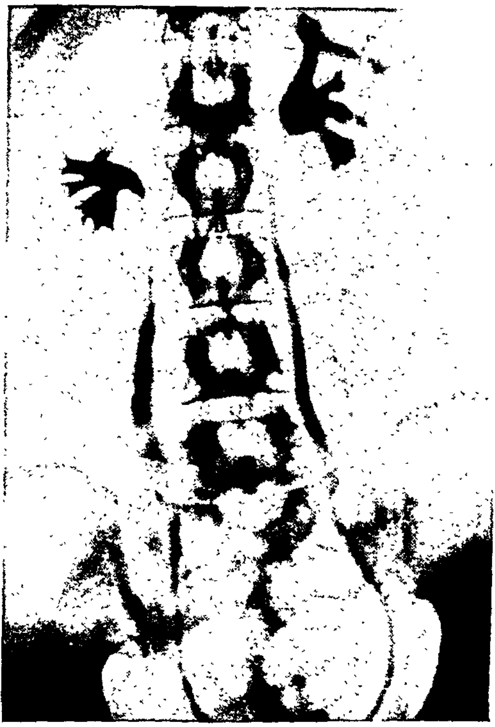

FIG. 11. Bilateral retrograde pyelo-ureterogram in the same patient three weeks after operation. The right kidney pelvis, calyces and ureter are within normal limits urographically and functionally regarding urea excretion and phthalein elimination. The left pyelo-ureterogram also reveals a left pelvis and ureter within normal limits. The patient is free from symptoms after right heminephro-ureterectomy for adynamic double kidney.

It is important to understand what the mechanics of the emptying of a double kidney is. Inasmuch as this anomalous kidney is usually in a certain degree of nephroptosis, and the two ureters, crossing one another, are always anatomically adherent to the parietal peritoneum, which they continually traumatize, it is inevitable that each ureter will interfere with the drainage of the other by interrupting its normal physiological peristaltic contractions. This will naturally cause retention in both pelves of the double organ, producing pyelectasis, calyectasis and dilatation of the ureters. Urinary stasis results from this interference with the dynamism of the kidney, with the result that a small hydronephrosis is formed, accompanied by crises of pain. The partial retention of urine in the pelvis of the kidney and in its two ureters not only produces chronic pyelitis, pyelonephritis and pyelo-ureteritis but also acts as a constant insult to the parietal peritoneum, which is responsible for the attacks of abdominal pain with nausea and vomiting, simulating those observed in appendicitis. The dynamics of the physiologic emptying of the renal pelvis is interfered with and the emptying time retarded, due to the faulty mechanics of the double organ and its double ureters. This interference leads in the course of time to further disturbance, with a tendency to the complete destruction of the renal parenchyma if the malformation is not surgically corrected.

The delayed urograms taken one or more hours after intravenous injection of the opaque substance show clearly this delay in emptying time of the organ, and disclose the actual condition present. The retardation indicates the impaired dynamism of the organ, which in my case was clearly revealed in the ninety-minute film, both renal pelves and both ureters of the double kidney being still distended with the opaque substance (Fig. 1), whereas in the normal kidney the physiological emptying time is from five to fifteen minutes.

The conservative surgical treatment of double kidney with a gross pathologic lesion, visualized in the urograms, has been amply discussed in the literature and need not be stressed at this time. Operations for heminephrectomy and partial resection of the kidney in cases of this type have been performed from the time of Albarran,[3] Tuffier,[4] Paoli,[5] Czerny[6] and other surgeons of the pre-urographic era. More recently this conservative operation for relief of associated gross pathologic lesions in the double kidney has been carried out by Legueu,[7] Papin,[8] Young,[9] Eisendrath,[10] Kretschmer,[11] Goldstein and Abeshouse,[12] Hess,[13] Campbell,[14] Gutierrez[15,16,17] and a host of others. In fact many cases have now been reported in the literature in which heminephrectomy has been done in a double kidney, but only when it has been associated with a gross lesion urographically revealed.

These, however, are not the type of case with which I am concerned in this presentation. All these authors were dealing with gross pathologic conditions, such as stone, cyst, large hydronephrosis, pyonephrosis, tuberculosis and even tumor in one-half of the double organ, all of which frankly demanded surgical intervention. In the group of cases of double kidney in which I am here interested, there is, on the contrary, no gross conditions visualized in the urogram. However, the delayed intravenous urograms will give a hint of what we are dealing with, and the retrograde pyelograms taken with the patient in the erect position will actually disclose the nature of the condition, which consists in the *faulty dynamism of a double kidney*, which is responsible for mechanical failure of the double organ to empty properly and results in the gastro-enterorenal syndrome. This condition can definitely be relieved and cured by a conservative heminephrectomy or hemi-ureteronephrectomy, as in the case here reported.

This type of operation is simple, since there is always a good line of demarcation between the two halves of the double kidney, and each half has an independent blood supply. (Fig. 6B.) The fear of bleeding during the resection of the kidney is groundless, since proper ligature of the blood supply is easily made and the raw surface of the resected kidney can readily be covered with fat to prevent hemorrhage. (Fig. 7C.) In the case here reported there was no bleeding whatsoever. As the two pelves of the double organ are entirely independent of each other, there is no danger of urinary fistula. Even if a calyx has to be resected, it can be sutured properly to prevent leakage. The operation should always be followed by a nephropexy to secure good drainage from the remaining single ureter of the heminephrectomized kidney.

In the group of cases in which there is a history of a previous abdominal operation without relief of symptoms, no other type of conservative operation seems so rational as a heminephrectomy or hemi-ureteronephrectomy, since it gives assurance of a permanent cure. Other conservative procedures that have been envisaged for double kidney and ureter, particularly in cases of hydro-ureter and hydronephrosis, include pelvio-ureteral anastomosis, anastomosis of the two ureters at any level, transplantation of ureters into the bowel or into another portion of the bladder, simple nephropexy and even denervation or decapsulation of the kidney. But none of these conservative procedures seems to offer promising results. Some cases of ureteral anastomosis have completely failed to correct the dynamic dysfunction and have come finally to a secondary nephrectomy.

The technic of heminephrectomy and hemi-ureteronephrectomy is as simple as that of lumbar nephrectomy and should be carried out, since it has the advantages not only of correcting the malformation and overcoming the painful symptoms, but also of conserving renal tissue and securing normal renal function.

SUMMARY AND CONCLUSIONS

1. Double kidney with double ureter is the commonest of all congenital malformations of the upper urinary tract, and when accidentally found demands a complete urologic and urographic examination.
2. The double kidney with bifurcation of ureters is a potential source of dynamic dysfunction of the urinary system, resulting not only in painful urinary symptoms but also in repeated crises of abdominal pain.
3. These recurring attacks of abdominal pain with gastrointestinal symptoms are due to the constant insult inflicted upon the parietal peritoneum by the adynamic double kidney and its crossed double ureters.
4. The anomaly of the double kidney *per se*, without association of visualized gross pathologic lesions in the organ, is responsible for these painful symptoms.
5. Every patient suffering from repeated attacks of indefinite abdominal pain should be submitted routinely to urologic studies, especially when the pain is on the right side, in order to rule out an anomalous surgical condition of the kidney.
6. When the physiologic emptying is retarded or incomplete in one or both pelves of the duplex organ, there is always evidence of a surgical condition.
7. Delayed urograms taken one or more hours after intravenous injection of the opaque substance are of great value in diagnosis, but an adynamic condition thus revealed should always be confirmed by retrograde pyelographic studies.
8. Heminephrectomy or partial resection of the double kidney with the corresponding supernumerary ureter appears to be the operative procedure of choice, offering the best prospect of restoration of function and complete disappearance of symptoms.
9. Heminephrectomy is as simple an operation to carry out as an ordinary lumbar nephrectomy.
10. The technic of heminephrectomy for correction of a double kidney is described in detail and graphically illustrated.
11. This conservative surgical procedure should be followed by nephropexy to straighten the ureter and secure good drainage from the remaining half of the double organ.
12. Conservation of tissue in renal surgery is imperative whenever feasible.
13. Patients submitted to this orthopedic correction of the double kidney should have a complete urologic and urographic postoperative check-up to confirm the anatomic and functional results before leaving the hospital.
14. When the double kidney is urographically discovered and is associated with painful symptoms and dynamic dysfunction, the condition should always be considered surgical even in a so-called "normal double kidney."
15. An illustrative case is reported to demonstrate the practical applicability and the excellent results of heminephrectomy in adynamic double kidney.

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When intranasal tuberculosis extends to the nasal bone or nasal process of the maxilla, it causes necrosis, cold abscess, and fistulization of the cutaneous structure.

From "Tuberculosis of the Ear, Nose, and Throat," by Mervin C. Myerson (Charles C. Thomas).

MESENTERIC THROMBOSIS*

CASE REPORT

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THE occurrence of mesenteric thrombosis is infrequent enough to warrant a report of our case and a brief review of the pertinent literature. Hertzler and Wangensteen report the prognosis as universally grave. However, in the case to be discussed uneventful recovery followed operation.

CASE REPORT

Mrs. M. M.; a thirty-six-year-old white female, entered the hospital August 15, 1943, with a history of acute abdominal pain of two days' duration, generalized over both lower abdominal quadrants. This was accompanied by chills, fever, and vomiting, but no diarrhea. No bowel movement had occurred during this time. An oil enema given on admission was returned with no results.

Past history was essentially irrelevant except for an appendectomy thirteen years ago and a cesarean section five months previous to admission.

Physical examination revealed an apprehensive patient with a temperature of 96°F., pulse 130 and thready, and respirations 30 and shallow. Blood pressure on admission was 210/100 but rapidly fell to 80/50. The skin became cold and clammy and the patient went into shock. The abdomen was distended, rigid, and tender to palpation; however, no tumor was present. On percussion, dullness was evident particularly over the flanks.

Urinalysis showed a clear specimen with a 1.021 specific gravity, three plus albumin, three plus sugar, and two plus acetone. Microscopically, two to three red blood cells and two to five white blood cells per field with many hyaline casts were seen. Examination of the blood gave evidence of hemoconcentration with a hemoglobin of 130 per cent (Salhi), red blood count of 6,500,000 and a white count of 34,600. Differential count showed 93 per cent polymorphonuclear leukocytes and 7 per cent lymphocytes. A tentative diagnosis of intestinal obstruction was made.

Immediate shock treatment was instituted and 250 cc. of blood plasma were given intravenously followed by 1,000 cc. of 5 per cent glucose in normal saline. As soon as the shock was relieved, a laparotomy was done under nitrous oxide and ethylene anesthesia. On entering the peritoneal cavity, a large quantity of bloody fluid was found. A segment of ileum four feet in length, (middle part of ileum) was found to be hemorrhagic, edematous, and dilated; the color was a dark purple. Hot abdominal packs applied to the dilated segment failed to produce any change in its color. The portion of the mesentery anchoring the involved part of the ileum was hemorrhagic and revealed thrombosis throughout the secondary arcade of veins, while a constricting band was found at the base of the mesentery. During the operation, 500 cc. of blood and 500 cc. of normal saline were given, together with 10 minims of neosynephrine to maintain the blood pressure. The involved portion of the intestine was resected and a side-to-side anastomosis done. During the operation, blood pressure fluctuated from 90/70 to 130/90, but the patient's condition improved immediately after the operation when a second blood transfusion was given.

Postoperative treatment consisted in giving 1,000 cc. of 5 per cent glucose and normal saline every eight hours and gastric (Wangensteen) suction to prevent abdominal distention. The temperature remained at 100°F. for one week after which it returned to normal. The postoperative course was complicated by the appearance of a focal nephritis the first day after operation, when the blood pressure rose to 190/100 and urinalysis gave a specific gravity of 1.022, three plus albumin, 100 red blood cells per field, and many coarse granular casts. The urinary output was about 1,100 cc. in twenty-four hours. This picture gradually improved and by the eighth day postoperatively the blood pressure returned to normal and the urine was clear. The patient was discharged on the twenty-first postoperative day.

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* From the Surgical Service of Dr. Thorvald Petersen, Fairview Hospital, Minneapolis, Minnesota.

COMMENTS

Occlusion of the mesenteric veins is more commonly seen today than in the past because it is diagnosed earlier. It occurs more frequently in males than in females in a ratio of two to one.[1] It prevails during the fifth decade of life and although rare in infants and old individuals, Laufmann and Scheinberg[1] report cases in infants of ten days and in patients of eighty years. The site of the thrombosis varies and may occur in the portal vein or any of its tributaries. In a series of twenty-five cases of mesenteric thrombosis Laufmann and Scheinberg[1] found fifteen cases of portal vein occlusion, eight cases of superior mesenteric and only two cases of inferior mesenteric vein occlusions. Wangensteen[2] quoting Trotter (1913) finds that mesenteric thrombosis occurs in 40 per cent and mesenteric embolism in 60 per cent of cases of mesenteric occlusion.

The history of mesenteric thrombosis dates back to Tiedemann who reported the first case in 1842. Virchow was the first to describe its pathological picture and reported one case in 1847. The first operation was performed by Elliot in 1895. Jackson, Porter, and Quinby in 1904 revealed 214 cases reported up to that time while Moore,[3] in 1941, reviewed the literature and added eight cases of his own. According to Bell[4] about 770 cases of occlusion of the mesenteric vessels both arterial and venous have been collected up to 1940.

The etiology of mesenteric thrombosis has been fairly well established and five main factors are believed to be responsible. They are: (1) peripheral sepsis, (2) portal obstruction, (3) mechanical obstruction, (4) blood dyscrasies and (5) trauma. Cokkinis[5] believes the first to be the more frequent cause. Infection may reach the mesenteric veins from any of the organs drained by their branches. Portal obstruction may be caused by pressure on the wall of the vein or cirrhosis of the liver. Blood dyscrasies such as polycythemia rubra, and leukemia are contributing factors. It also appears that abdominal operations play a definite rôle in causing mesenteric thrombosis. Injury to the mesentery or mesenteric veins during operations and the formation of postoperative adhesions appear to be the most important mechanical means by which thrombosis is initiated. Badin[6] reported a case of appendiceal abscess and extensive inflammation of the mesentery with thrombosis of the mesenteric vein supplying the distal 10 cm. of the ileum. Macroscopically, the intestines show patches of dark blue discoloration which becomes more progressive and assumes the appearance of generalized congestion of the intestinal wall. Red infarction gradually develops with hemorrhaging into the lumen of the intestine and bloody fluids extravasates into the peritoneal cavity. The extent of the lesion may vary from an area of several centimeters in length to all of the small and half of the large bowel. However, many cases occur in which portal occlusion alone is present without involvement of any of the large or small intestine. Moore[3] states that vascular disturbance does not always leave permanent structural changes. When the blood supply to the bowel is slowly cut off, there may be no symptoms of occlusion during life and little abnormality of the intestine at autopsy.

The clinical picture of mesenteric thrombosis depends upon the extent of involvement of the mesentery and the intestine. The degree of vascular occlusion and the rapidity of spread probably account for the occurrence of acute and chronic cases of venous thrombosis. In chronic cases, a history of intermittent low abdominal pain, paroxysmal in nature, coming on after meals, and not showing any definite localizations is usually observed. Acute cases usually develop severe colicky abdominal pain, very sudden in onset, which is followed by vomiting and shock. Bell[4] states that chronic cases show a 50 per cent spontaneous recovery. Wangensteen[2] remarks that many cases of mesenteric thrombosis run a fairly mild course, a week often elapsing before an abdominal lesion is suspected. Intestinal obstruction occurs in only a few cases of venous thrombosis. Vomiting is often overshadowed by pain according to Fallis[7] while the reverse is true in obstruction of the small intestine. Vomiting in some cases may relieve the pain. Constipation is often present and the presence of blood on rectal examination confirms the diagnosis. Bloody diarrhea may be present depending upon the extent of hemorrhagic necrosis. The differential diagnosis should include hemorrhagic pancreatitis, acute cholecystitis, perforated peptic ulcer, and acute intestinal obstruction.

Immediate operation is the treatment of choice and the prognosis in most cases is directly proportional to the time elapsing before intervention. The mortality rate is very high, approximately 84 per cent in an operated series of nineteen cases by Whittaker and Pemberton. It can be reduced only by earlier diagnosis and prompt operative intervention. Exteriorization of the involved section is inadequate and invariably leads to peritonitis. A lateral anastomosis should be done while small localized lesions may be left unoperated.

SUMMARY

The case of venous mesenteric thrombosis is reported and the pertinent literature reviewed. An evaluation of the symptoms of mesenteric thrombosis is offered and an attempt made to clarify the diagnosis. Early surgical intervention is emphasized. The case reported was interesting because of successful operation with recovery and because of the occurrence of a complicating renal picture developing the first day after operation.

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CALCIFICATION OF THE PANCREAS

CASE REPORT

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PANCREATIC lithiasis is a relatively rare pathological condition. It was first described by Regner DeGraff in 1667. The most recent summary of literature by Haggard and Kirtley in May, 1932, reported only 204 cases during a period of 271 years. Of these 204 cases, 139 were non-operative and sixty-five were operative. However, since this review of literature appeared there have been numerous case reports. Among those who have had case reports since Haggard are: Moss and Fries, two cases; Stanford and Byrnes, one case; Faust and Brandstett, one case; Moulten, one case; Rockwern and Snively, two cases; Winnett and Caldwell, one case; Poppel and Levy, three cases; Thomason, four cases; Townsend, three cases; Snell and Comfort, eighteen cases. This would bring the totally reported number of cases, including the one herein reported, to 241 cases.

There are two distinct types of pancreatic stones: (1) those in which true pancreatic stones are found in the pancreatic ducts, corresponding to stones in the gall ducts or ureters; (2) false stone or calcification of the gland in which the stones are found chiefly in the parenchyma, and less often in the ducts. This case is of the second type. This second type of calcification of the pancreas is much rarer according to King and Waghelstein, who reported four cases of their own in 1942 with only eleven other cases in the literature.

The stones may vary in number from one to several hundred and are usually very hard of a greyish white cast and resemble salivary calculi. Those that have been examined were found to be composed of calcium carbonate and calcium phosphate. They are found in all parts of the gland substance and are found in the ducts of Wirsung and Santorini, and also in cysts and in ectatic cavities. However, they are most commonly found in the duct of Wirsung in the head of the gland.

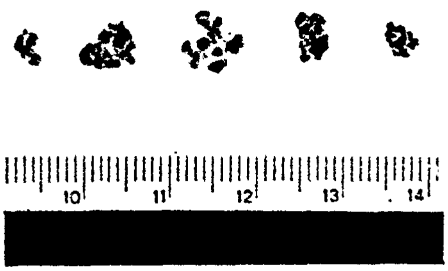

FIG. 1. Stones removed from duct of Wirsung.

Etiology. The exact manner of formation of pancreatic stones is somewhat in question. One theory is that the formation is similar to gallstones, that is due to obstruction of the flow of pancreatic secretion with resulting pancreatic stasis and infection in the ducts. The fact, however, that they are usually composed of calcium carbonate and calcium phosphate, which is not found in this form in normal pancreatic secretion has been altered by an inflammatory process with resulting deposition of calculi within the ducts, and this second theory would seem to apply rather than the other in the case herein described.

Symptomatology. The clinical symptoms of the condition are varied and unreliable, and this accounts in part for the rarity with which the clinical diagnosis of the condition is made. The most important symptom is pain. This may range from attacks of obscure epigastric pain to severe colic resembling gallstone colic. This epigastric pain radiates often to the back or shoulders and often to the left side and into the left costal vertebral angle. Nausea and vomiting are often present in the acute attacks. In cases in which there is considerable pancreatic damage, symptoms include fatty stools, loss of weight and diabetes mellitus. Jaundice is not a particularly characteristic symptom, although in many cases a history of jaundice at some time or another is often present. The main condition with which this may be confused is with cholelithiasis. The pain in pancreatic stone is often nearer the midline and this is a most important aid in diagnosis, but the only positive way in which a diagnosis can be made is through the use of *x*-ray. Pancreatic stones are easily demonstrated by *x*-ray as they cast a denser shadow than gallstones. Scattered throughout the gland, their location is very typical. Although present in the plate they are often overlooked as they were in this case.

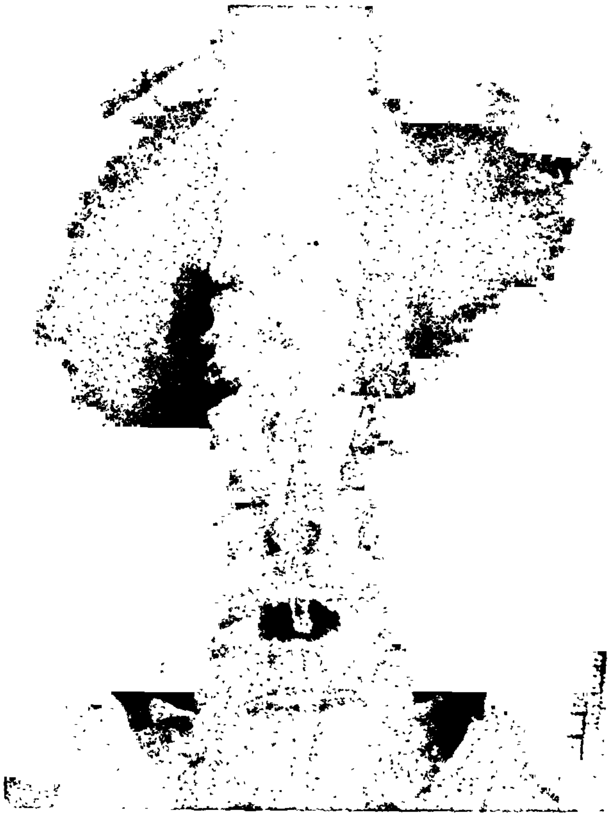
Fig. 2. Postoperative *x*-ray; anteroposterior view showing calcified areas in pancreas.

The treatment of pancreatic stones is surgical removal. In cases of diffuse calcification of the gland as here described, it is obviously impossible to remove all the stones. However, the results from removing the stones from the duct which were causing acute colic as in this case are good. The removal of obstructive stones in this instance resulted in amelioration of symptoms. The results of operation in general have been rather satisfactory and the mortality rate is not excessive. The operative approach depends upon the location of the stones. The most common approach is through the gastrocolic omentum into the lesser peritoneal cavity. Others make the incision in the mesocolon and still others expose the pancreas through the gastrohepatic omentum. The latter approach was used in this case. Pancreatic fistula or digestion of the wound edges or pancreatitis has not proved common following surgery. The number of operative cases now stands at about seventy-five or eighty with a mortality of about 10 per cent. Following surgery the medical treatment should consist of dietary measures, use of hydrochloric acid for elimination of calcium salts as advocated by Loebar, and the use of pancreatin as in the case of chronic pancreatitis. Early diagnosis followed by appropriate treatment before destruction of the pancreatic tissues has occurred can best be achieved by bearing the possibility of this condition in mind, and by the use of the flat roentgenographic plate in all gastrointestinal examinations.

CASE REPORT

The patient, G. L. S., age thirty-nine, a white male, was admitted to St. Jerome Hospital, Batavia, New York, on September 16, 1942, at 4:15 P.M. with a complaint of abdominal pain and vomiting. His past history was as follows: In November, 1929, he was operated upon at St. Jerome Hospital for a fracture of the patella sustained in an automobile accident. Following this he remained in good health. During the years 1932, 1933 and part of 1934 he drank excessively, but in the latter part of 1934 or in early 1935 he stopped drinking entirely. His first symptoms referable to the gastrointestinal tract began during 1936, and were dyspeptic symptoms. He complained of indigestion and discomfort or distress in the epigastrium, but did not have much gas or any severe pain. During the following year he lost about twenty pounds and began to notice a loosening of the bowels. About this time he began to receive medical attention. In 1938, he had a severe attack of jaundice, lasting about six weeks. During 1939 and 1940, he began to have infrequent attacks of moderately severe epigastric pain and continued to lose weight. During 1940, he had a severe attack of pain which disabled him for about ten days. Every three or four weeks he would have an attack of pain and gas, which lasted for a day or two. In December 1941, he had a gastrointestinal series which was pronounced negative for gallstones or ulcers. At this time the pancreatic calcification was observed but was misinterpreted as probably being due to stomach powder in the intestinal tract. This fact was found out after operation. In 1941 and 1942, the patient dieted and took antacids and stomach powders, but the attacks increased in severity until the time of admission to the hospital.

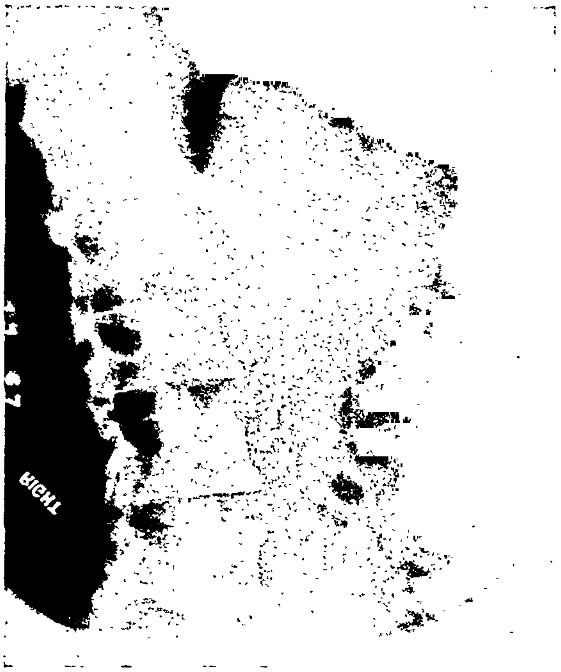

Fig. 3. Postoperative x-ray taken in oblique view to throw shadow in head of pancreas away from spine; shows well the impossibility of complete surgical removal.

On admission to the hospital the patient complained of epigastric pain and slight tenderness in the right lower quadrant. His temperature was 98.8°F., pulse 88, respiration 20, white blood count was 16,850, urine was negative for sugar or albumin, specific gravity 1.022, hydrogen ion concentration 7.0 microscopically negative. A diagnosis of probable acute appendicitis was made and in view of the long gastrointestinal history it was decided to do an exploratory operation at the same time. Ether anesthesia was used, and a right paramedian incision was made. The appendix, which was moderately inflamed, was removed. The upper abdomen was then explored and a hard crepitant area was found. This was thought to be stones in the gallbladder, but on extending the incision the gallbladder was found to be normal and the hard crepitant mass was still palpable higher in the epigastrium. Upon further extending the incision this area was found to lie above the lesser curvature of the stomach and to be a calcification or lithiasis of the pancreas. Incision was made through the gastrohepatic omentum, exposing a hard, greyish calcification. An incision was made upon this calcification which released a small amount of fluid and the stone was removed. It was found to lie in the duct of Wirsung, which was probed about 1½ inches in each direction and three or four other stones were removed. This seemed all that could be done although there were many other calcifications present. After removing a small section of tissue of the incision, the pancreas was sutured with chromic catgut and the abdomen was closed in layers with two cigarette drains to the region of the pancreas.

Fig. 4.

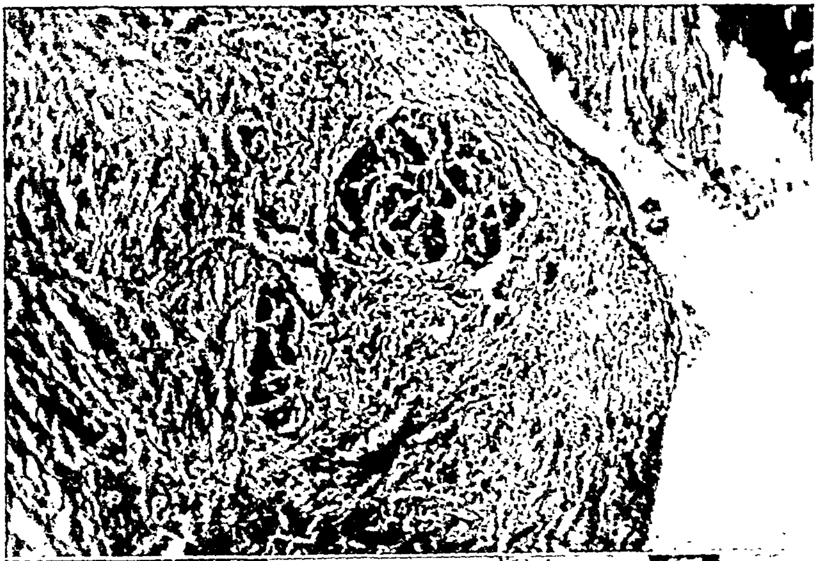

Fig. 5.

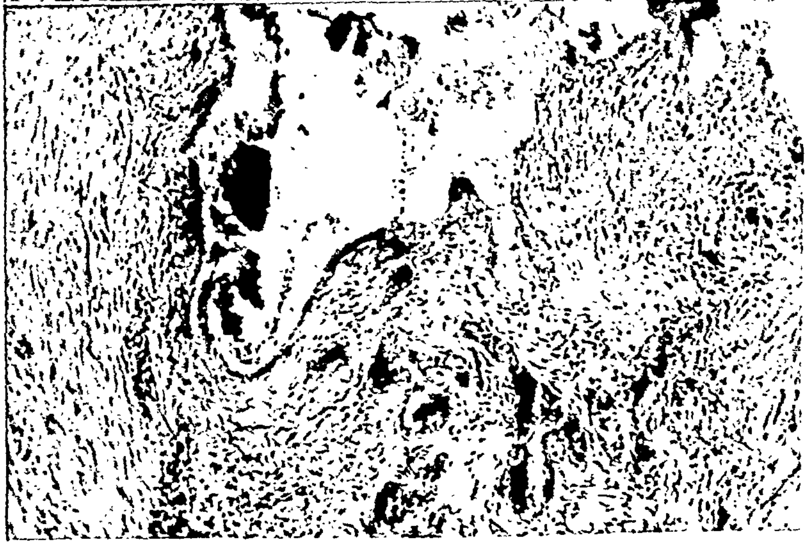

Fig. 4. Microphotograph of pancreatic tissue showing typical islet with dense fibrous tissue and considerable round cell infiltration.

Fig. 5. Microphotograph of pancreatic tissue showing dense fibrous tissue and large duct filled with calcareous matter.

The pathological reports were as follows: Specimen: An appendix 6 cm. long, to 7 mm. wide. The wall was not strikingly thickened. The lumen contained light brown inspissated firm fecal matter.

Microscopic: The lumen of the appendix was obstructed and distended by inspissated fecal matter. The mucosa showed a number of small scars containing rather many eosinophilic leucocytes. The lymphatic tissue was markedly reduced in some areas. The remaining follicles showed large secondary follicles.

Diagnosis: Obstruction and scars within the mucosa; no evidence of purulent inflammation or tuberculosis.

Specimen: Four calculi with corrugated, greyish to light brown surfaces, having a diameter from 2 to 3 mm. and a mass of soft tissue measuring 12 : 3 : 3 mm. On cross section this appeared to be a segment of a duct-like structure which held embedded another small calculus 2 : 2 : 1.5 mm. in size.

Microscopic: Sections showed that the soft tissue was composed mainly of dense fibrous scar tissue that included many small arteries and nerves and some comparatively large hollow spaces which were compatible with small pancreatic ducts. Their epithelium was mostly shed off and replaced by small superficial round cell infiltrates but, here and there, especially in small folds or sinuses a columnar epithelium was seen for a certain distance. One of these ducts showed a distended segment, sinus-like, filled with calcareous matter. Within the scar tissue several fragments of glandular lobules were observed, one showing definitely the architecture of a Langerhans islet.

Diagnosis: Pancreatic calculi located in small ducts, the surrounding pancreatic tissue having been replaced by fibrous scar tissue; no evidence of tumor or malignancy.

Postoperatively the patient did very well, the most annoying complication being a rather persistant cough. One drainage tube was removed on the fifth postoperative day and the other on the ninth postoperative day. The patient was discharged on the eleventh postoperative day. He returned to his home and was getting along very nicely for about two weeks when he had a severe abdominal pain with marked distention of the abdomen and was readmitted to the hospital. He remained there for three days and the pain was relieved promptly by morphine and cathartics. Following this episode the patient's recovery was one of progressive improvement and after three months he returned to work as a defense worker. At the present time he is better than he has been in some time and has very little indigestion or gas, although he watches his diet carefully and takes glutamic acid and pancreatin three times a day. Unfortunately, he has developed a postoperative hernia for which he wears a support. This gives him very little in the way of symptoms.

CONCLUSIONS

1. Pancreatic lithiasis and pancreatic calcification are relatively rare.
2. The cause of calcification and formation of stones of the pancreas is somewhat obscure.
3. The symptomatology is not clean cut and often resembles cholelithiasis.
4. In the acute cases the colicky pain in the epigastrium and radiating to the left back is the most characteristic feature.
5. In long standing cases with destruction of pancreatic tissue, loss of weight, steatorrhea and diabetes mellitus may occur.
6. The positive diagnosis can be made only roentgenographically.
7. Treatment is surgical.
8. An operative case still under observation is reported.

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EARLY POSTOPERATIVE MECHANICAL INTESTINAL OBSTRUCTION FOLLOWING THE REMOVAL OF A RUPTURED, GANGRENOUS APPENDIX*

[illegible], M.D.

[illegible]

I[illegible] in the early postoperative period following the removal of a ruptured, gangrenous appendix [illegible]

It was decided to investigate all the deaths resulting from such mechanical obstruction during the period from [illegible] to [illegible], in order to determine methods by which the diagnosis of mechanical obstruction in the postoperative period might be made, and how it might be distinguished from paralytic ileus due to a diffuse peritonitis. There were seven such cases.

CASE REPORTS

CASE I. L. S., [illegible] years of age, was operated upon April 16, 1943. A gangrenous, ruptured appendix was removed, and thick purulent material was found free in the peritoneal cavity. Sulfanilamide powder and three rubber drains were inserted. The temperature was 103°F. (rectal). The abdomen was distended, but not rigid, and continued to be so the following day, when the temperature dropped to 101°F. (rectal), following the use of intravenous salt solution. Treatment consisted of continuous Wangensteen drainage, intravenous fluids, sulfonamide solution, and blood transfusions. *On the third postoperative day* the abdomen was soft and distended, gas was passed per rectum, and peristalsis was heard. The temperature ranged from 100°F. to 101°F. (rectal). On the fifth day the drains were removed. A milk and molasses enema and hypodermic prostigmin were given. Gas and feces were expelled. However, the abdomen [illegible] the patient expired.

[illegible]

CASE II. M. G., [illegible] years of age, was operated upon on May 1, 1943. A ruptured appendix was removed. Free pus was seen in the peritoneal cavity. Rubber drains and sulfanilamide were placed in the abdomen. The temperature at this time was 101°F. There was [illegible] in the patient's condition the following day. On the second postoperative day the abdomen was described as distended. There were several bouts of vomiting. Wangensteen drainage was used for several hours. Prostigmin was given hypodermically without effect. *On the third day* the drains were removed. The abdomen was still distended. Peristalsis was not heard. The temperature at this time was 101°F. On the fourth day the abdomen was more distended, tense, and somewhat tender. A small semisolid stool followed the use of an enema. The temperature remained down until the sixth day when it rose to 102°F. The abdo*men became* more distended, vomiting was frequent, and the patient soon succumbed.

At autopsy organizing exudate was seen obstructing the small bowel about three feet from the cecum. The intestines proximal were distended and filled with liquid and gas. The bowel distal was collapsed. No other free exudate was seen. Microscopy revealed a minimal bronchopneumonia and moderate atelectasis of the lung bases.

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* From the Surgical Services and Pathology Department of the Jewish Hospital.

CASE III. S. W., sixteen years of age, was operated upon in January, 1938, and a ruptured appendix was removed. Free pus was found in the peritoneal cavity, and three drains were inserted. The temperature was 101.6°F. On the first postoperative day the abdomen was described as distended and somewhat tender. The patient vomited several times. Wangensteen drainage was used for the next twenty-four hours. The temperature was 101°F. The following day the symptoms continued, but fluids were allowed by mouth. The temperature fell to 99°F. *On the third postoperative day* distention became severe. Peristalsis was heard. An enema and prostigmin were ineffective. The temperature at this time was 98.6°F. Distention progressed the following day. Turpentine stupes and pitressin were again ineffective. There was no change, and the temperature remained normal until the eighth day, when it rose to 101°F. The drains were shortened on the tenth day. Due to the progressive distention it was decided to use the Miller-Abbott tube for decompression on the thirteenth day, but the patient expired soon after.

At autopsy a collection of organizing pus was found involving a loop of small bowel about six and one-half feet from the ileocecal junction. The proximal bowel was markedly distended. No other peritoneal reaction was seen.

CASE IV. E. T., thirty years of age, was admitted on September 26, 1936, with a diagnosis of acute pelvic inflammatory disease of two days' duration. No operation was performed. The temperature on admission was 101.4°F. The following day the abdomen was slightly tender, but peristalsis was heard. An enema was given without effect. The temperature remained the same. On the second day (corresponding to a postoperative day in the other cases) the abdomen became more distended, and the patient vomited several times. The temperature ranged on that day from 99.6°F. to 101.4°F. The patient had a liquid bowel movement and passed some gas. *On the third day* the abdomen was even more distended. Peristalsis was barely audible, but the temperature fell to 98.6°F., and remained so for two days (third and fourth days). On the seventh day peristalsis was heard, but the abdomen remained distended. The temperature did not exceed 100.6°F. On the eighth day the patient developed a sharp pain in the left leg. The temperature rose to 103.6°F. The abdomen remained distended and was now tender. An enema resulted only in the passing of a small amount of flatus. The patient died the same day.

At autopsy a perforated, gangrenous appendix was found. There was a localized peritonitis in the right lower quadrant surround loops of small bowel. The intestinal tract proximal to this point was distended. There was no bowel gangrene. There was an early terminal bronchopneumonia microscopically.

CASE V. R. S., fourteen years of age, was operated upon for a ruptured, gangrenous appendix on February 18, 1939. The temperature on admission was 99.4°F. Free pus was found in the peritoneal cavity, and three Penrose drains were introduced. On the first post-operative day the abdomen was slightly distended. No gas or feces was passed. The temperature remained the same. The following day distention continued, and the temperature dropped to 98.6°F. *On the third postoperative day* the patient passed gas per rectum, although the abdomen remained distended, and peristalsis was not heard. On the evening of the same day the patient complained of severe pain in the left leg. The following morning the temperature rose to 103.8°F. From then until death on the seventeenth day the temperature fluctuated between 99.4°F. and 105°F., the phlebitis became worse, abscesses of the leg developed, and terminally a Staphylococcus aureus septicemia resulted. During the entire course the abdomen was markedly distended. Distention failed to respond to enemas or stupes. No stools were passed. Peristalsis was heard on several occasions. Wangensteen drainage was used intermittently.

At autopsy a localized collection of organizing exudate was found in the right lower quadrant. A loop of small bowel was trapped in the exudate. The bowel proximal was markedly distended. Although death here was largely due to the septicemia, the distention probably played some part. The true nature of the ileus was not recognized before death.

CASE VI. A. M., fifty-seven years of age, was operated upon March 20, 1938, and a ruptured appendix was removed. Free pus was seen in the peritoneal cavity, and several drains were introduced. The temperature on admission was 103°F. On the following day the abdomen was distended and tender. Peristalsis was heard. No flatus was passed. The temperature fluctuated at this time from 100°F. to 101.4°F. *On the third postoperative day* the temperature dropped to 98°F. The abdomen was more distended. Peristalsis was barely audible. Some gas was passed spontaneously the following day. The patient expired on the fifth day. The highest temperature was on the evening of the fourth day, when it reached 100.6°F. There was no bowel movement at any time.

At autopsy exudate was found only in the right lower quadrant where it was obstructing a loop of small bowel. There was distention proximal to the obstruction.

CASE VII. A. U., forty-seven years of age, was operated upon August 16, 1937, and a ruptured appendix and free pus were found. The appendix was removed, and two drains were inserted: The temperature on admission was 102.4°F. On the first postoperative day the patient was allowed sips of water, but this was promptly vomited. On the second day the patient complained of "gas pains." The abdomen was distended. No peristalsis was heard. Pitressin was given hypodermically without effect. No gas or feces was passed. These symptoms continued until the fourth day when the distention became severe. Six hundred cc. of fluid were removed from the stomach by tube. The patient died the same day. The temperature on the second postoperative day varied from 98.4°F. to 100°F.; *on the third day*, from 98°F. to 99°F.; on the fourth day it rose suddenly to 103°F., when the patient expired.

At autopsy organizing exudate was seen in the right lower quadrant. A loop of small bowel was obstructed at this point. The bowel proximal was distended. The bowel distal was collapsed. No other peritoneal reaction was seen.

All the patients were seen and operated upon the second day following the onset of symptoms. In all the pulse rates varied with the temperature. When distention became severe, the respiratory rate usually rose out of proportion to the temperature. In only three cases were white blood cell counts done repeatedly. In all of these there was a drop from at least 13,000 cells per cubic millimeter with 92 per cent neutrophiles to under 9,000 cells per cubic millimeter with a normal differential on the fourth day. After this time the counts were somewhat elevated.

COMMENTS

While the diagnosis of small intestinal obstruction due to adhesive bands occurring weeks or years after operation is easily made, the recognition of mechanical obstruction in the immediate postoperative period is usually difficult. In addition, when free pus is discovered at operation for a ruptured appendix, the obstruction that develops is often attributed to a paralytic ileus associated with a diffuse peritonitis. It must be appreciated, however, that the body resistance often overcomes the general infection, localizing it, and that the organization of such collections of purulent material is capable of involving and obstructing the bowel. The incidence of local peritonitis following ruptured appendices varies in different reports. Penberthy et al.[15] report 183 of 1,653 cases of appendicitis, with only one death. At autopsy gangrene of the small intestine due to an adhesive band was found. W. E. Ladd, in a discussion of the same paper, reports seventy-five cases of ruptured appendices treated with chemotherapy, in which there was a death due to intestinal obstruction and sepsis. Stillman[17] found 124 cases of ruptured appendices in which thirteen developed acute ileus. Obstruction in twelve of the thirteen was found in the small intestine, and all were due to adhesions. In thirty-four cases of acute ileus complicating acute appendicitis with abscess or diffuse peritonitis, Van Beuren[18] reports that the mortality was 56 per cent of which 47 per cent (of the 56 per cent) were due to mechanical ileus. It must be appreciated that acute ileus of the mechanical type can produce death. Miller,[11] in a study of 343 surgical cases of intestinal obstruction, found that the mortality increases the longer the obstruction exists. If ileus is present for more than ninety-six hours, the mortality reaches 84 per cent. The mechanism of death is as yet unknown. Some believe that even in diffuse peritonitis with ileus, distention is the important factor.[15] Others believe it is due to toxic absorption from the peritoneal cavity. Still others claim that hypochloremia subsequent to vomiting is the important factor. It may well be that all these play some part.[1] In cases of mechanical obstruction absorption from the peritoneal cavity is not present, but a combination of the other factors may still be active.

In an analysis of the cases presented in this report it is worthy to note that none was suspected of having mechanical ileus. The following features were present in all cases: First, the temperature, elevated early, gradually subsided until the third postoperative day, when in no case was there a temperature over 100°F. orally (or 101°F. rectally), and in most the temperature was between 98.6°F. and 99.6°F. Second, after the fourth postoperative day the temperature rose again until death several days later (except in the case complicated by phlebitis and Staphylococcus aureus septicemia, in which case the temperature was due to the infection). Third, distention started soon after operation, was progressive, and failed to respond to stupes, prostigimin, or pitressin. Only one patient had abdominal pain as a prominent symptom. Most of the patients had bowel movements and passed flatus almost to the day of death.

It appears that only on the third and fourth postoperative days is the temperature down in all the cases while distention is present. Before the third, and after the fourth day, the temperature is often quite elevated, and the picture of a diffuse peritonitis with ileus is stimulated. This picture is recognized as consisting of an elevated temperature, abdominal distention, and toxicity. Four cases of diffuse peritonitis with paralytic ileus following ruptured appendicitis were found in the postmortem records. In these the temperature fluctuated from 99°F. to 104°F. from the first day to the end. At no time was there any stabilization of the temperature below 100°F. for forty-eight hours. The abdomen in all was distended, and feeble peristalsis was heard in two cases. Consequently, the third postoperative day is the critical one in differentiating the two types of ileus. It is reasonable, I believe, to assume that before the third day the temperature is elevated since there is some degree of diffuse peritoneal irritation still present, and the body is attempting to localize it. When the inflammation is localized, the temperature falls to low levels. After this time the progressive abdominal distention, already present for a few days, is responsible for the gradually climbing temperature curve. Abdominal distention on the first two postoperative days may occur following any abdominal operation. However, it responds well to ordinary measures employed. In order to be significant, the distention should be progressive and persist beyond the third day.

The prognosis, of course, varies for the two types of ileus. Much more can be done for the mechanical type early. We must recall that if mechanical ileus persists too long, the mortality rises. Early recognition and active treatment (operative or medical decompression) are necessary.

SUMMARY

1. Seven deaths associated with mechanical ileus in the early postoperative period following the removal of ruptured appendices are presented.
2. A low temperature (under 100°F. orally) on the third postoperative day, in the presence of persistent abdominal distention, with or without peristalsis, is indicative of a mechanical, rather than a paralytic obstruction.
3. The presence or absence of bowel movements is unreliable as an aid in diagnosis.
4. Early recognition and treatment will lower the high mortality rate of unrelieved mechanical obstruction.

Since the completion of this paper, I have had the opportunity to see a number of cases, all of which fitted into the clinical picture described. In each instance the diagnosis of mechanical obstruction was made and proved correct by either operation or the rapid improvement following intensive medical therapy. Since we are more adept in differentiating beginning mechanical obstruction from diffuse peritonitis, and confident in our conclusion, we do not hesitate to give large, repeated doses of parenteral prostigmine and pitressin quite early (third postoperative day), with the hope of breaking any early adhesions. We have been definitely successful with this program, and have had to operate on only one patient in whom the obstruction persisted. At operation well organized adhesions were found in the right lower quadrant of the abdomen. I believe it is a safe procedure to persist with medical treatment for twenty-four hours. If there is no improvement in this period, it is best to operate before distention becomes severe.

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DISASTROUS SEQUELAE TO THE WEBSTER-BALDY OPERATION

CASE REPORT

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REPORTS of disastrous sequelae to the Webster-Baldy operation for retroversion of the uterus are appearing with increasing frequency in medical literature.

Its technic was developed at the turn of the century and was reported by Webster in 1901,[23] and Baldy[2] in 1903. The latter reviewed his experience with it in 1909[3] and each reported again in 1915,[4,24] at which time Baldy gave Andrews credit for having been the first to perform this operation.

While both men emphasized its use for only carefully selected cases, and Webster described in detail steps to prevent adhesions to raw surfaces or hernia through the broad ligament opening, neither reported a postoperative complication.

Richardson[18] reported the first disaster in 1920. For the twenty-three years since then, fourteen others have been found in the literature. The following seems to be the sixteenth case to be presented.

CASE REPORT

The patient was a forty-five-year old, well controlled diabetic. As she strained to open a window, there was sudden onset of a mild pain in the lower left side. This continued and was soon accompanied by nausea and occasional vomiting.

The early hours of this episode were not unlike many such spells during the past twelve years. As these were frequently associated with the menses, she had been under treatment for dysmenorrhea and proceeded to follow her usual routine of bed rest, heating pad and mild sedation.

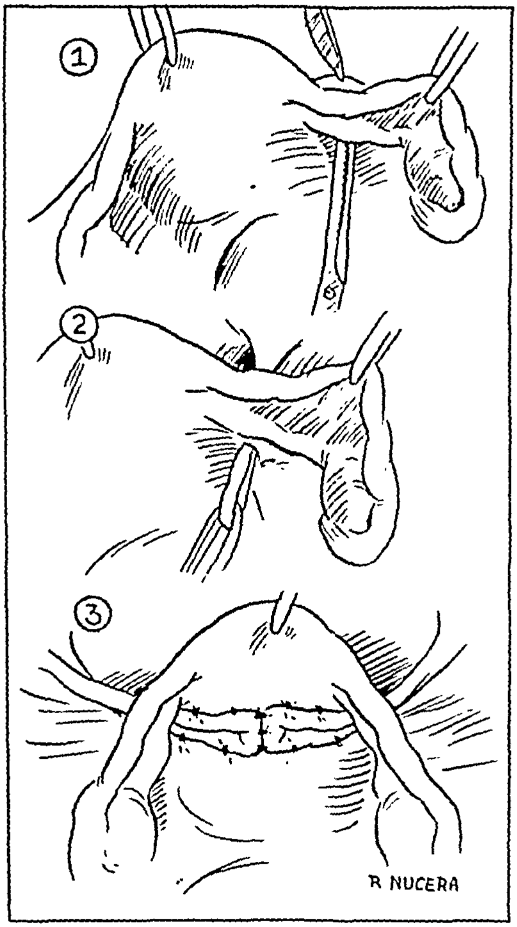
The nausea persisted with occasional retching, and the pain increased in severity, spreading toward the epigastrium. After several hours, the patient became pale and cold, her pulse slow and weak. She was obviously acutely ill and was admitted to St. Johns Hospital, Yonkers, New York.

On further examination the temperature was 99.6°F., the pulse 60, regular but weak, respiration, 16; blood pressure, 100/60; skin, cold and damp. The abdomen moved freely with respiration and was not distended. Peristalsis was present and seemed normal. No masses were palpated but there was definite tenderness in the left lower quadrant. Vaginal examination revealed the presence of a fluctuant mass in the left fornix. This was moderately tender but too soft to be outlined. The leucocyte count was 19,600 with 93 per cent polymorphonuclear cells. Urinalysis was negative. Diabetes as a causative factor was quickly ruled out.

The patient's prostration was out of all proportion to the clinical findings, and it was obvious that there had been a castastrophe which she could not long survive. An exploratory laparotomy was done about twenty hours after the onset of the illness.

At operation there was a moderate amount of bloody, peritoneal fluid. Several loops of small intestine were herniated from the anterior side through an opening in the left broad ligament. The mesentery of this portion of bowel was twisted upon itself causing strangulation. The affected intestine was purplish-black, and its peritoneal covering necrotic enough to be partially rubbed off in handling. There was very little bowel distention, the proximal segment being no larger than the distal. A finger was inserted in the broad ligament opening and the tube and ligament severed, thus freeing the incarcerated intestine. The gangrenous area which was sharply demarcated from healthy bowel proved to be 55 cm. in length. This portion was resected, a lateral anastomosis performed, and the abdomen closed without drainage.

The pathological diagnosis was (1) gangrene of small intestine, and (2) thrombosis of mesenteric veins.



Figs. 1 to 3. The broad ligament is perforated immediately under the utero-ovarian ligament close to the uterus, and the round ligament drawn through the opening. 3, Fixation of the round ligaments to the posterior surface of the uterus.

Postoperative distention was controlled with a Miller-Abbott tube. The recovery was complete. In the two years since operation there has been no recurrence of the previously periodic attacks, and the patient has enjoyed better health than in many years.

This woman had been operated on fourteen years before by a distinguished New York surgeon. Through a suprapubic paramedian incision, he had performed an appendectomy and "sewed the stomach up a little higher."

Suspecting that a Webster-Baldy procedure had been done, the old records were obtained and this was found to be the case. The fixation had not held, the aperature in the left broad ligament remaining patent. The right was not examined.

A search of the literature indicates that while this is a fairly common operation, its popularity along with other surgery for retroversion is on the decline. Of the sixteen cases reported with disastrous results, fifteen, including this one, resulted from herniation of small intestine through the perforations in the broad ligament through which the round ligaments had been drawn.

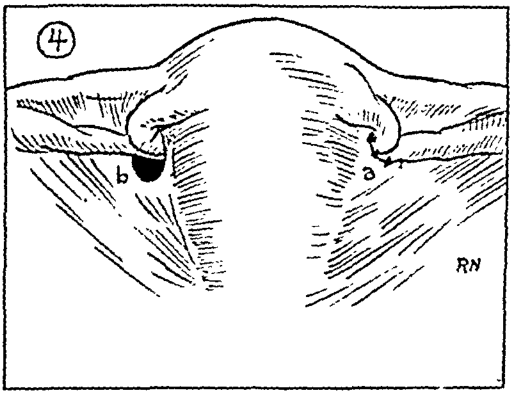


Fig. 4. *a*, The edges of the opening in the broad ligament sutured to the round ligament. *b*, Possible aperture resulting when these sutures are omitted.

Two reasons have been advanced by other reporters for the presence of these orifices in the broad ligaments. Both were considered to be the result of failure to follow the technic as described by Webster: (1) Not properly closing the openings by stitching their edges to the round ligament; (2) drawing the round ligament through the broad ligament too far lateral to the uterus, thus producing tension on and later laceration of the broad ligament.

Webster,[24] in his 1915 paper, said, "The broad ligament is perforated with a curved forceps immediately under the utero-ovarian ligament close to the uterus." After describing the fixation of the round ligaments to the posterior surface of the uterus he continued, "The next step is important; viz., to close the openings in the broad ligaments stitching their edges to the round ligaments so that no raw surface is left and no chance for the development of a hernia."

The sixteenth case, one of acute intestinal obstruction, seen by the University of

Chicago Clinics[11] thirty days after a Webster-Baldy suspension, was caused by adhesions at the site of the plication of the round ligaments. The broad ligaments were intact.

The case being presented differs from the others in that the broad ligament perforation was present as a result of the failure of the fixation to hold.

Pemberton and Sager[16] reported a case seen twelve years after a Webster-Baldy operation. While doing a myomectomy they discovered bilateral perforations of the broad ligaments where the round had been drawn through. While symptomless, this was potentially just as dangerous as any of the others.

In reviewing these cases, one is impressed with several things: (1) Every case imperiled life and called for emergency surgery. (2) In no instance was a complete preoperative diagnosis made. (3) At least seven had suffered periodic intestinal upsets for one, two, six and twelve years. Four were cured of these attacks by the second operation and the other three patients died. (4) Except for the cases that obstructed in twenty-four and thirty days, the interval was from two to nineteen years, with an average of about ten years.

Case	Year Reported	Age	Interval Since W-B Operation	Hernia through Broad Ligament	Other Pathology	Interval Symptoms	Bowel Resection	Result
Richardson	1920	42	2 years	Yes	0	0	0	Recovered
Pemberton and Sager	1929	39	24 days	Yes	0	0	Yes	Recovered
University of Chicago Clinics	1934		30 days	0	Adhesions	4 days		Recovered
Strickler	1935	32		Yes	0	1 year	0	Recovered
Arnold	1938	34	9 years	Yes	0	6 years	Yes	Recovered
Parkes and Karabin	1939	45	15 years	Yes	0	0	Yes	Recovered
Parkes (Hagan)	1939		10 years	Yes	0	0	0	Recovered
Schumann and Beechman	1939	30	3 years	Yes	0	0	0	Recovered
	1939	40	4 years	Yes	0	2 years	Yes	Died
Bowles, H. E.	1939	42	16 years	Yes	0	0	0	Recovered
Owen and Kelly	1940	44	19 years	Yes	0	12 years	0	Died
Sakimoto, R. Y.	1940	42	Old	Yes	0	0	Yes	Recovered
Bickers, W.	1941	31	1½ years	Yes	0	0	0	Recovered
Bickers, W.	1941	19	2 years	Yes	0	3 attacks		Recovered
Mayo, Stalker and Miller	1941	47	16 years	Yes	0	Yes	Jejunostomy	Died
Pulrang	1943	45	14 years	Yes	0	12 years	Yes	Recovered

These observations make one wonder how many unreported disasters there have been following cases of uterine suspension and also how many women may be skirting this disaster at the present time.

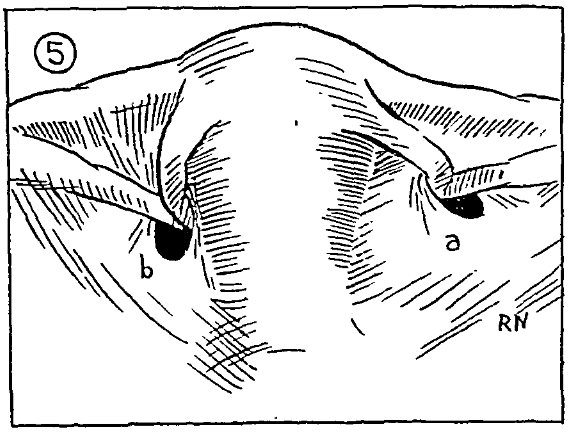


Fig. 5. Openings torn in the broad ligaments when the round ligaments are brought through them too far from either (*a*) the uterus or (*b*) the utero-ovarian ligament. This is thought to happen even when primary sutures have been placed as in Figure 4*a*.

In 1909, after twelve years experience with about one hundred Webster-Baldy operations, Baldy[3] in reviewing the subject wrote, "Retrodisplacements of the uterus are mostly coincident with other lesions, and where such is the case, the symptoms almost universally come from the associated disease." Surgery was recommended in only carefully selected cases. He repeated this statement in 1915,[4] adding, "nine-tenths of all retroversion operations being done are unnecessary," and "The number being done is limited only by the number of females in the country."

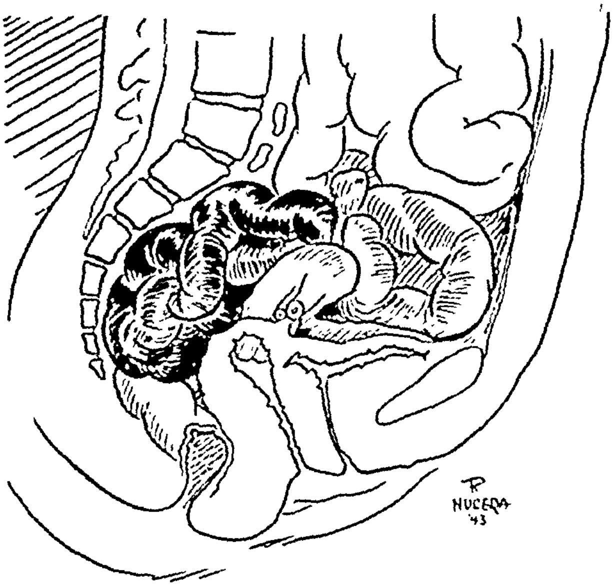


Fig. 6. Herniation of small bowel, from the anterior side, through a perforation in the left broad ligament. The incarcerated segment is gangrenous. This took place twelve years after a Webster-Baldy operation which failed to hold, leaving a residual orifice in the broad ligament.

These statements were made at a Symposium on Operative Treatment of Retroversion of the Uterus held before the Philadelphia Surgical Society in December, 1914. An incredible number of cases were reported, four hundred by one man, nearly a thousand by another, without a single instance of postoperative disaster being mentioned. Hernia was obviously considered since several discussed procedures to prevent its occurrence. At that time about fifty technics had been tried, but those of choice seemed to have been the Webster-Baldy and the Gilliam with its various modifications.

These two continue to be the most frequently used in surgical interference for retroversion, but the incidence of operation is greatly decreased and complications are being reported more frequently.

In an editorial written in 1925 Bevan[5] drawing on his long experience, reviewed three recent cases and recalled fifteen to twenty other cases of intestinal obstructions following fixation operations of the uterus (not the Webster-Baldy type). The purpose of his article was to condemn all operative procedures for retroposition of the uterus as not being justified because of the poor clinical results and the risks involved.

In more recent literature, Michael,[14] in 1936, reported two cases of intestinal obstruction following suspensions of the Gilliam type and cited two more by Peterson of Denmark. Searle[20] reported one following ventrofixation. Schumann and Beecham[21] cited one each by Churtro and Matheson, bringing the total found in the preparation of this paper to ten.

In addition to these reviewed, H. Pohl and Votquenne have reported a strangulated hernia of small intestine after a Baldy-Dartiques operation for retroversion. This appeared in a Belgian Journal of Surgery in 1938, which was unobtainable for review.

In casual conversations at Surgical meetings during the past two years the writer has heard of three additional unreported cases.

One's conclusion is that this postoperative complication is more prevalent than the medical literature to date would indicate.

SUMMARY

Fifteen cases of postoperative disaster of the Webster-Baldy operation found in the literature have been reviewed and the sixteenth is presented.

Fifteen of these resulted from herniation of small intestine through the broad ligament perforations, one from postoperative adhesions.

The acute episodes occurred on an average of ten years after the Webster-Baldy suspension. Seven patients suffered interval intestinal symptoms.

Most of the case reporters believed that the risk of these intra-abdominal hernias developing could be minimized by carefully following the correct technic.

The case presented resulted from failure of the suspension to hold.

Incidental to this investigation, reports of ten cases of acute intestinal obstruction resulting from other types of uterine suspension operations were uncovered.

In no case was a complete preoperative diagnosis noted.

While the reported incidence of disastrous sequelae is low, these twenty-six recorded cases afford a sufficiently comprehensive study to constitute a serious indictment against operative treatment for retropositions of the uterus.

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FRACTURES OF THE CARPAL NAVICULAR BONE WITHOUT DIRECT TRAUMA

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MUCH has been written concerning fractures of the navicular bone. However, I do not believe that it has been well recognized that fractures of this bone may occur without direct trauma, such as falls and direct blows to the hand.

I have seen two cases in the past eighteen months in which fracture has occurred from sudden twisting of the wrist. The purpose of this paper is to emphasize the importance of re-*x*-raying, within two or three weeks, so-called strains or sprains of the wrist, particularly when the patient complains of severe pain just distal to the wrist joint, and where disability is more marked than one would expect from a simple sprain.

In the first case, the patient was swinging a hammer. In order to avoid hitting someone, he attempted to stop the swing and felt this sudden pain in the wrist. He was *x*-rayed immediately and no fracture was found. He, however, kept complaining of pain in this area and I treated him with diathermy and massage and encouraged him that eventually the wrist would heal.

In order to ally his fears, about three weeks later, he was re-*x*-rayed, on his insistence, and much to my surprise found a well defined fracture with beginning decalcification along the fracture line.

He was immobilized with a non-padded plaster cast, and it took six months of continual immobilization to secure eventual union. The final result was good, except for a slightly diminished power of grip.

In the second case, the patient was lifting a propeller blade from one end of the table to the other end. He slipped on an oily floor and in order to prevent the blade from falling, his wrist was forced backward. He was *x*-rayed immediately and *x*-ray reports came back as being negative. The roentgenologist was told to examine the navicular bone very carefully. The patient continued to complain of pain in his wrist. This time, being on the lookout for this fracture, I did not wait to have the *x*-ray suggested by the patient and *x*-rayed it after two weeks as a routine. This time, not to my surprise, I found a well defined fracture through the body of the navicular bone with beginning separation of the fragments. He was immobilized from July 27, 1943, to September 16, 1943, in a non-padded plaster splint and good union resulted. He was then given a leather wrist gauntlet to continue to wear for another month. At the present writing, the man has good use of the wrist and hand, and is not wearing anything.

COMMENT

These cases have been reported to emphasize the importance of realizing that this bone can be fractured without direct trauma and from sudden flexion of the wrist either dorsally or laterally. It should be routine procedure to *x*-ray all sprains of wrists immediately and then again, routinely, in three weeks, preferably in two weeks. By this time, devascularization will have produced its effects on the blood supply of the bone to make the fracture line visible.

As far as treatment is concerned, a well molded, non-padded splint is the treatment of choice. There must be no motion of the hand in this cast. Very often, in applying these casts, there is some play in the region of the metacarpals where the cast is applied. No matter how slight this play is, it is enough to interfere with the result. These patients are given detailed instructions to report immediately whenever the cast appears even slightly loose. They are also given adhesive tape to rein-force the distal end of the cast tightly around the metacarpals. This cast should be kept on until there is definite evidence of obliteration of the fracture line. It is not enough to visualize calcification; the fracture line must have disappeared. This as a rule takes a minimum of three months and sometimes takes six months. The patient should be told of this fact, so that he will not be too discouraged. After the cast is removed, if some support is not given, it frequently happens that the fracture reopens. I, therefore, prescribe a leather wrist gauntlet as shown in Fig. 1. This should be worn for approximately three to four weeks.

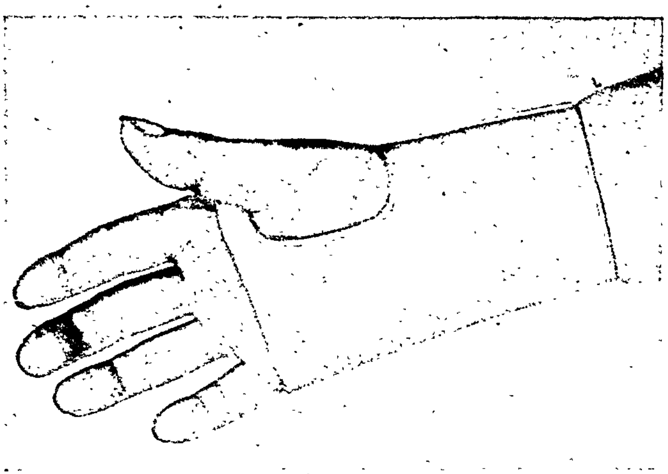

Fig. 1. Leather wrist gauntlet, used following removal of cast in navicular fractures.

The patient should be encouraged to use the hand while in the cast as much as possible, as there is a tendency to osteoporosis of the carpal bones as a result of the long immobilization.

In 90 per cent of the cases, it has been shown that most of these fractures will heal with immobilization alone. As a matter of fact, many of the good results ascribed to drilling and other procedures to promote healing of this fracture, have been explained by some authorities by the prolonged immobilization following these operations.

SUMMARY

1. Two cases are reported of fracture of the carpal navicular bone without direct trauma.
2. Importance of immediate and two or three week follow-up x-ray of all sprains is emphasized.
3. Treatment of the fracture is discussed, with importance of prolonged immobilization and follow-up leather wrist gauntlet.

* * *

PRIMARY ABDOMINAL PREGNANCY

CASE REPORT

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THE criteria set up for the acceptance of the authenticity of a reported case of primary abdominal pregnancy are (1) normal appearance of tubes, ovaries and broad ligaments; (2) absence of penetration of the space between the broad ligaments by the fimbriated extremity of the tubes; (3) absence of intraligamentary rupture of the tube and (4) lack of evidence of escape of the ova from the uterine cavity. The majority of the cases are not primary implantations on the peritoneum, but are secondary to tubal abortion or ruptured tubal pregnancy.

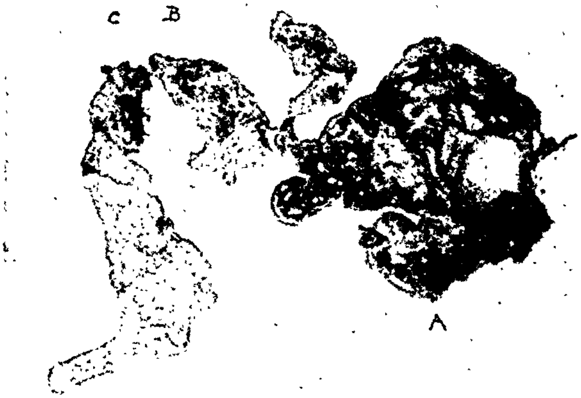

FIG. 1. A, fetus *in situ;* B, appendix epiploicum of sigmoid; C, appendix. B and C were invaded by the chorionic villi.

The case herewith reported appears to conform with requirements and due to the rarity of the condition merits recording.

CASE PEPORT

Mrs. E. L., aged forty-two, a waitress married twenty-four years, had five children living and well. The youngest was sixteen years of age. All deliveries were normal. Her menstrual history began at thirteen years of age and menstrual periods lasted three or four days. No dysmenorrhea or metrorrhagia were complained of. The patient's present illness began on March 14, 1943, when she had her usual menstrual period. Instead of bleeding for three or four days she continued to bleed for twenty-two days. The bleeding was accompanied by pains in her lower abdomen, associated with nausea and a desire to defecate. On three occasions while sitting on the toilet she felt faint and began to perspire freely. Her family noticed a change of color in her face after each one of these episodes. The pains in the lower abdomen were cramp-like and intermittent and would last for one hour and then disappear. The attacks recurred at intervals of a week apart. The patient continued to work as a waitress up to the time that she presented herself for examination.

The patient was fairly well nourished, sallow complexioned and did not appear to be acutely ill. The conjunctivae were pale, pupils were equal and regular and reacted light and accommodation. Ears, nose and throat were essentially negative, blood pressure was 130/85. Heart and lungs were normal. The abdomen showed evidences of a soft distention most pronounced in the lower quadrants. Tenderness was elicited in both quadrants. No evidence of muscle guarding was noted. Pelvic examination revealed a relaxed perineum with slight cystocele and rectocele; the cervix was lacerated and directed anteriorly; the uterus felt enlarged, nodular and irregular. A mass could be felt in the cul-de-sac. This mass was firm, hard, non-tender and tilting of the cervix elicited no complaints of pain. Dark blood was oozing from the uterine canal.

Tentative diagnosis: Fibroid uterus with subperitoneal pedunculated fibroid impacted in the cul-de-sac.

Patient was admitted to the hospital on April 15, 1943, and under gas-oxygen-ether anesthesia the abdominal cavity was entered through a low midline incision. The uterus was enlarged, and showed evidences of numerous small sessile subperitoneal fibroids. Both tubes and ovaries were intact. When an attempt was made to deliver the pelvic ileum from the pelvis it was found to be attached to a large ovoid mass the size of an orange. After freeing the ileum, the mass was dark blue in color, had a glistening surface and was intimately connected with the anterior surface of the rectum. The cecum, appendix and the signoid were likewise adherent to the mass. Extending along the anterior wall of the rectum and attached to the posterior parietal peritoneum was a disc-like brownish tumefaction which peeled off with ease from the peritoneum. As the distal portion of the placenta was reached the cystic sac was opened and the amniotic fluid and fetus escaped into the pelvis. The major part of the placenta, sac and fetus was removed and the oozing was checked by compression. Part of the placenta, which was intimately attached to the anterior rectal wall, was left behind. The abdomen was closed in layers without drainage.

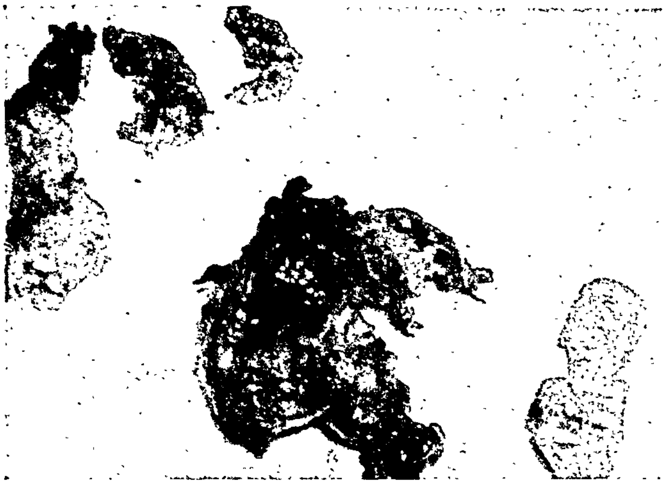

Fig. 2. Fetus removed from sac.

Postoperatively, the patient was given 250 cc. of plasma, and 500 cc. of blood. Intravenous glucose and saline were continued for forty-eight hours. Morphine and pantapon were administered for pain. The postoperative course was stormy for twenty-four hours; the patient suffered from shock and rectal bleeding. The later course was uneventful and the patient left the hospital at the end of sixteen days.

The fetus was 6 inches long, male, with a normal head, eyes, ears, chest, abdomen and extremities. The placenta measured 6 by 7 cm.

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SPONTANEOUS FRACTURE OF THE CALCANEUS*

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CONTRARY to the opinion held by many, a spontaneous or pathological fracture can appear in bone which appears healthy on *x*-ray; at least roentgen study of the bone shows no deviation from the normal, other than the fracture itself. The two chief causes for such a fracture are lues and the so-called "march" fracture. March fracture can be correctly included in this group since the etiological trauma is considered to be very minor in intensity although often repeated.

The following spontaneous or pathological fractures of the calcaneus are described in the literature:

March Fracture. In this type, of which two cases have been reported in recruits, the patient complains of pain in the heel, and the *x*-ray eventually shows a condensation line which clears up after a few weeks of rest.

Fractures in Tabetics. These are of two types: (1) Fracture through the calcaneus in which the posterior portion is displaced away from the major anterior portion with little evidence at repair of the fracture and in which walking can be considered the only cause for this injury. Two such cases are described, both occurring in tabetics. (2) Spontaneous fracture of the calcaneus, giving the appearance of a typical fracture of this bone with loss of the tuber-joint angle, but without the usual trauma. This is described in one patient, occurring in both feet, probably on a luetic basis.

Separation of the Apophysis. Separation of the apophysis is mentioned by Key and Conwell in their textbook on fractures. They advise treatment either by manipulation in plantar flexion, or else by open reduction. They cite no cases, however.

CASE REPORT

The present case is that of W. R., a fifty-four year old female, who, while walking on level pavement, suddenly had a severe pain in the right heel without any known cause. It felt as though "the heel of her shoe had broken off and her leg was sinking into the ground." The ankle immediately began to swell, her ankle and heel became very painful, and she could hardly walk home. This occurred on January 13, 1943.

The patient was seen in the out-patient department two days later, and a marked enlargement of the right heel and ankle was noted. The involved area was red and hot and extremely tender. A fair range of motion of the midtarsal and subastragalar joints was possible but painful. The motion of the ankle joint was extremely painful. The diagnosis of a pathological fracture, probably due to lues, was made, and the patient was admitted as an emergency to the orthopedic service. *X*-rays (Fig. 1) showed a fracture of the apophysis with a displacement upward of the proximal two-thirds.

On a previous admission to the hospital in 1942, the Wassermann report was three plus, and it was found that her husband had died of lues. She was admitted for correction of marked hallux valgus deformities with severe clawing of the other toes of both feet. These were treated by the Keller-Brandes operation for the big toes, and by capsulotomies and phalangectomies of the other toes.

The fractured calcaneus was treated conservatively. The foot was strapped in plantar flexion, and she was kept in bed for about six weeks. At the end of that time, the pain, swelling, and tenderness had practically disappeared. She was allowed to walk and was discharged on March 5th.

After her discharge, she was followed in the out-patient department. Final *x*-rays (Fig. 2) taken in April, about three months after her injury, showed firm union of the displaced

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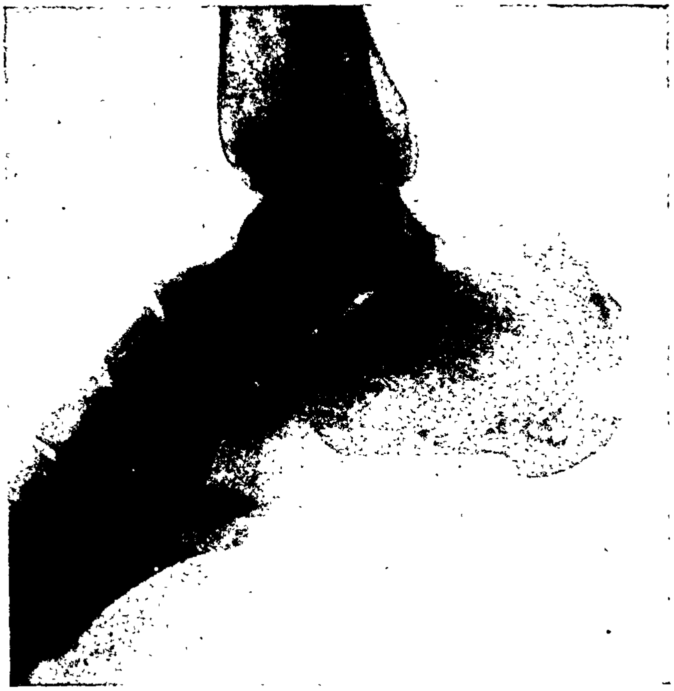

Fig. 1. Lateral view of foot and ankle five days after injury, showing fracture of the calcaneus with displacement of the upper two-thirds of the apophysis.

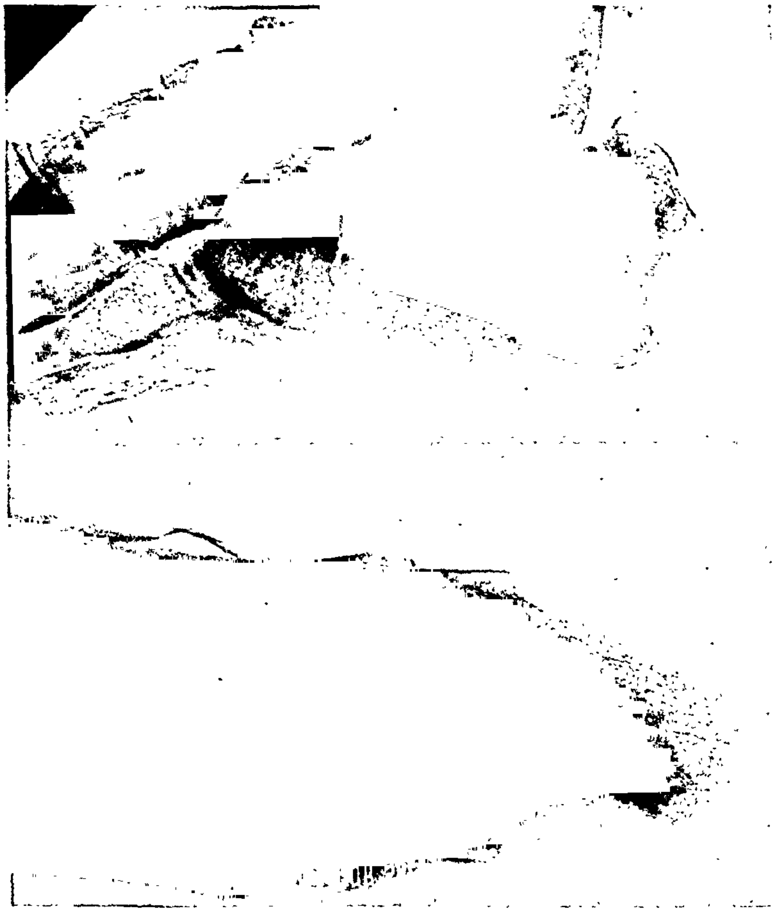

Fig. 2. Above: lateral view of the heel three months later, showing firm union of apophysis to body of calcaneus; below: sagittal view of the heel.

apophyseal fragment. At that time, her gait showed weakness of plantar flexion but this was improving.

SUMMARY

A case report is presented of a patient with a spontaneous fracture through the apophysis of the right calcaneus which occurred in a middle-aged woman with a previous history of lues. It was treated conservatively. The available literature includes no case with similar x-ray findings.

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POST-TRAUMATIC DEFECT OF THE HUMERAL HEAD

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THIS is a case of an injury to the shoulder in which the immediate finding was a fracture of the greater tuberosity, and subsequent study showed resorption in this area. This is an unusual occurrence; a similar condition has been recorded following dislocation of the shoulder but in this case the defect was the result of a simple fracture of the greater tuberosity.

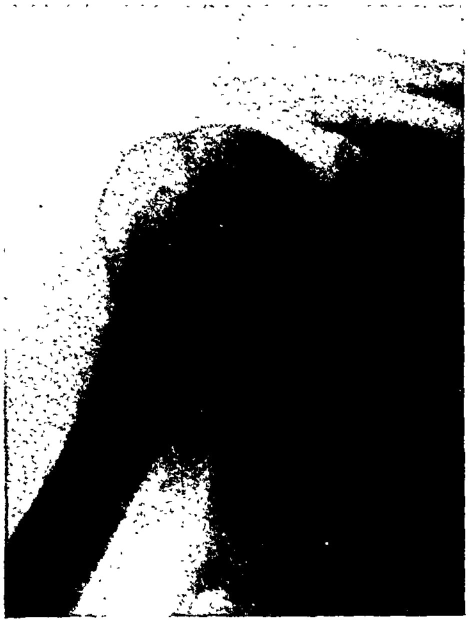

FIG. 1. Shows the fracture of the greater tuberosity when first seen.

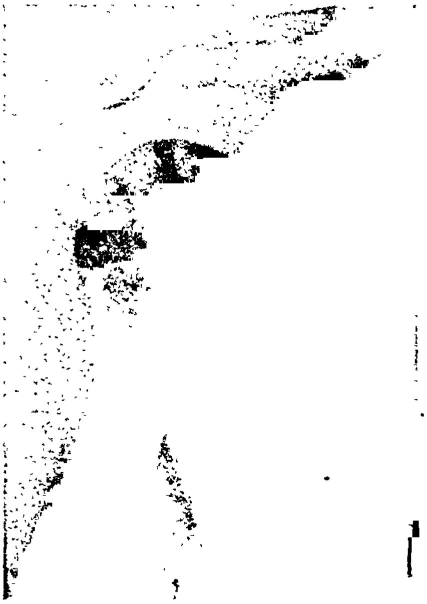

FIG. 2. Three and a half months later. Shows the v-shaped area typical of the grooved defect.

CASE REPORT

A woman, forty years old, was riding on a bus. This vehicle stopped suddenly and her right shoulder struck a protruding bar. Examination a few hours after the accident showed some discoloration of the upper part of the right arm. There was marked limitation of motion, but no evidence of a dislocation of the humeral head. A roentgenogram, taken the following day (Fig. 1) showed a fracture of the greater tuberosity. A shoulder sling was applied and three weeks later active and passive motion of her shoulder was initiated. In spite of the fact that the range of motion increased with time, the patient complained of a dull ache in the affected part. This ache was not ameliorated by the use of salicylates nor by the wearing of a sling. Although physiotherapy was given to the local part, the patient continued to have pain. This symptom increased in severity and, therefore, another roentgenogram (Fig. 2) was made of the shoulder (three and a half months after the accident). This showed a v-shaped area of bone absorption in the region of the greater tuberosity of the humerus.

The patient received physiotherapy and continued wearing the sling for another month. At last examination, six and a half months after the injury, she had almost complete range of painless motion. The diagnosis was comminuted fracture of the greater tuberosity of the right humerus with subsequent resorption.

Similar findings have been explained as follows: (1) congenital anomaly, (2) osteochondritis dissecans, (3) avulsion fracture with absorption of the fragment, and (4) aseptic necrosis following damage to the blood vessels.

The theory of congenital anomaly must be discarded because this condition would be observed at a very early age without a history of trauma. Almost all congenital anomalies are bilateral and practically all the reported cases in which this defect was observed were unilateral and followed some injury to the shoulder. Osteochondritis dissecans is found in patients of an earlier age group. Avulsion fracture is not an adequate explanation since one would expect to see the displaced fragment immediately after the injury. The theory of aseptic necrosis is untenable as this process does not appear on the roentgenogram for several weeks. Cases showing resorption of the humeral head have been noted on the initial roentgenogram following a single injury.

The explanation that seems most satisfactory is that of Hill and Sachs. They state that this defect is the result of a compression fracture caused by the impinging of the posterolateral surface of the humerus against the anterior rim of the glenoid and is not the late result of the dislocation of the shoulder. They refer to a case in which an autopsy performed twelve hours after the injury showed this defect in the shoulder.

A review of the literature indicates that this defect follows a dislocation of the shoulder, most often an anterior dislocation. One of the explanations of recurrent dislocation of the shoulder is based on this defect near the head of the humerus acquired at the time of the first dislocation. Sometimes this defect is not noted because the anteroposterior roentgenograms are taken in varying degrees of rotation. It is best demonstrated with the arm in marked internal rotation. A tangential view has been suggested; this is obtained by placing the film on top of the shoulder with the tube lateral and below the elbow with the arm internally rotated.

CONCLUSION

A case of fracture of the greater tuberosity of the humerus with subsequent resorption is presented.

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New Instruments

LATERAL TRACTION APPARATUS FOR THE UPPER EXTREMITY*

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THE bed treatment of fractures of the upper extremity is often necessary. Multiple injuries may force the surgeon to employ traction and extension to a bed patient when ambulatory means of fixation would otherwise be used. In addition, other conditions may require traction with arm flexed or extended. Loss of substance of a bone, particularly the clavicle or humerus, may be treated by lateral traction under certain circumstances. An arm amputation stump, a soft tissue contracture or a long standing dislocation may make such traction necessary or desirable.

It is astonishing, therefore, to find that very few hospitals have any standard apparatus for securing lateral traction on the upper extremity. This is particularly true of military hospitals where such apparatus is most often needed. A Jones arm splint is usually available for temporary care, but these excellent splints are unsuited to prolonged bed care of the patient, for they are uncomfortable, insecure, and do not allow for pulley and weight traction. Occasional paralysis of brachial nerves occur from pressure of the arm ring. Pressure necrosis of skin is not uncommon. A few other devices are improvised from time to time as the need arises, but most of them are clumsy and impractical. It seems desirable, then, to introduce a simple and adjustable lateral traction apparatus which can be constructed inexpensively by any small metal working or machine shop. The plans for such a splint are given in detail in Figure 1. The adjustable bed clamps described are suitable for any standard bed frame, but could, of course, be altered for the standard frame in the hospital in which it was to be used.

This splint can be taken apart and stored in very little space. (Fig. 2.) A screw driver is all that is necessary for its assembly, though the back of a knife can be used. The nuts on the pulley bolts can be tightened with the fingers. It can be used with or without the vertical arch as desired and is used conveniently for simple elevation of an infected hand, or to reduce edema about a wound or fracture of the upper extremity. Any portion of the splint can be padded as necessary for the particular use intended. It can be placed with its horizontal platform parallel to the surface of the bed, or raised at an angle of sixty or seventy-five degrees where it is secured by tightening the bed clamps on the braces at the desired level.

With the arm in traction and shoulder resting comfortably on a pillow, beneath which the cross-piece of the splint is placed, the device is very stable. (Fig. 3.) In nearly all cases, however, it has been thought advisable to have a single rope "safety-line" attached to an overhead frame to avoid any sudden shift in position of the splint if it should be bumped by a passer-by. This is not necessary for support, but is used as an added precaution.

The weight of the patient's body is used for countertraction and blocks are placed

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* The opinions or assertions contained herein are the private ones of the writer, and are not to be construed as official or as reflecting the views of the Navy Department or the Naval Service at large.

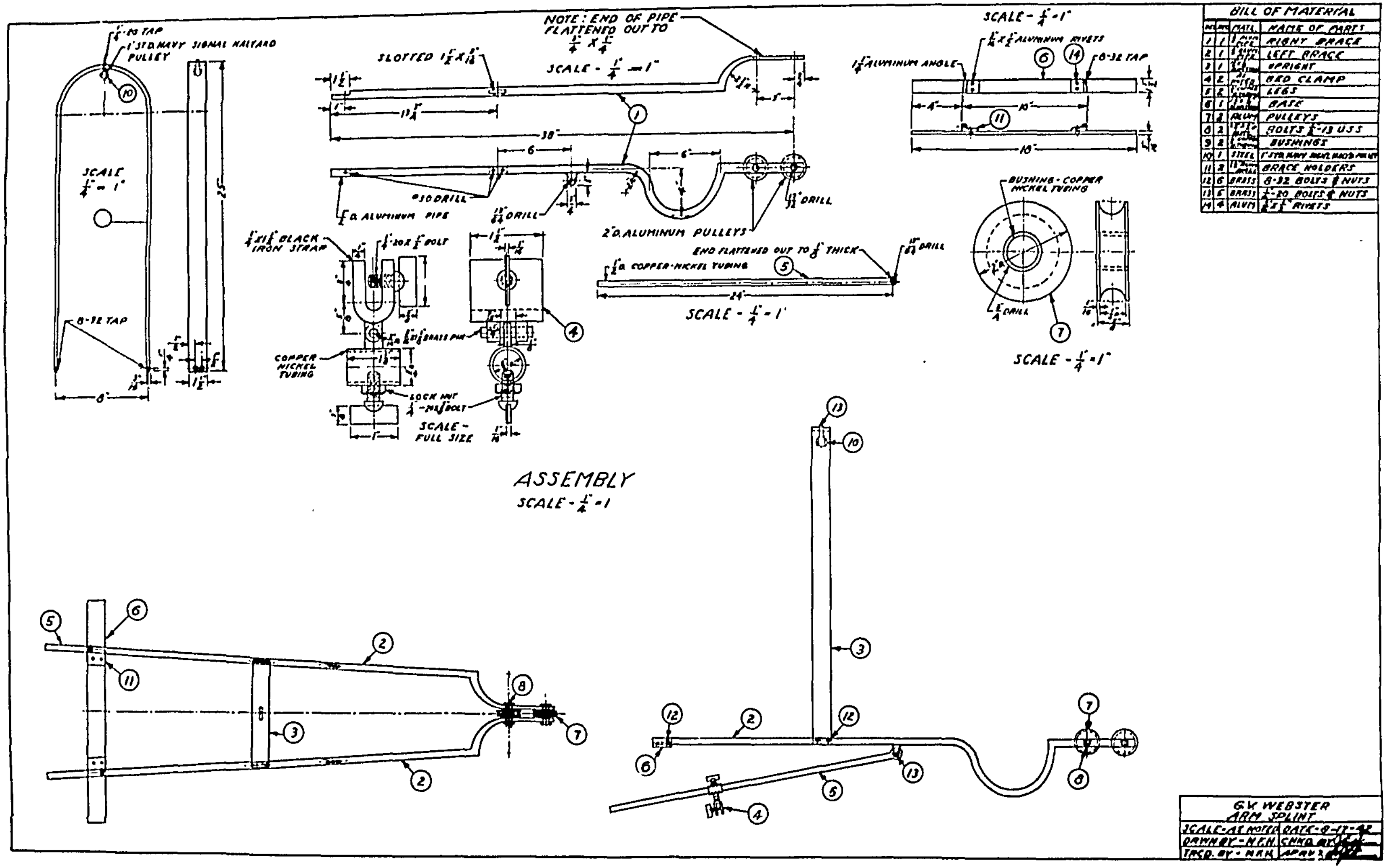

FIG. 1. Plans for apparatus.

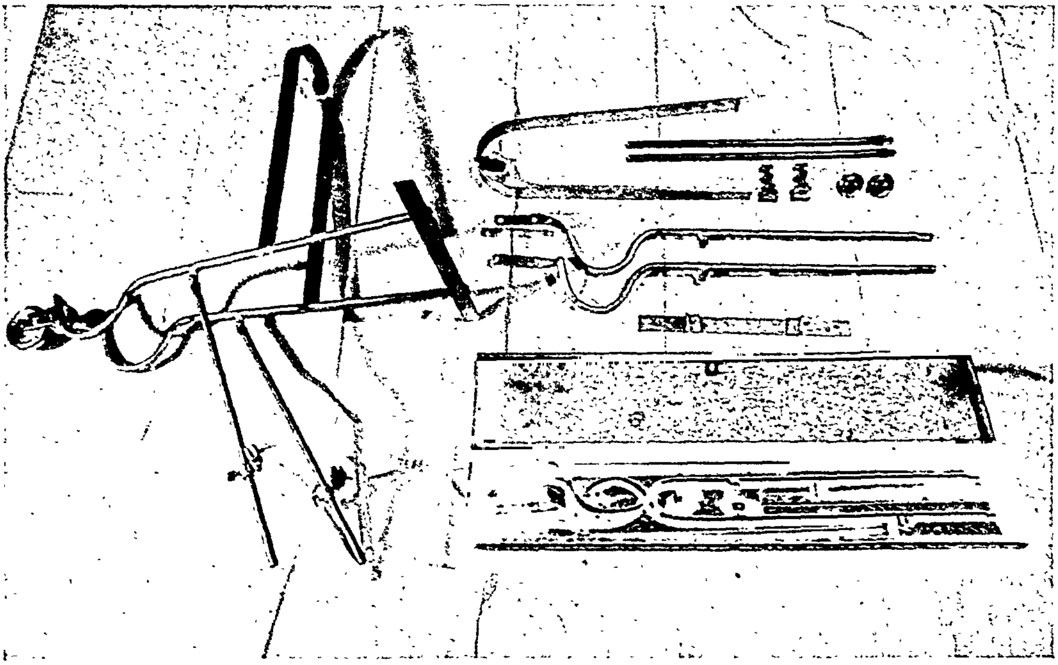

Fig. 2. The lateral traction apparatus can be assembled easily (left), taken apart (right above), or packed neatly in a small metal or wooden box (right below).

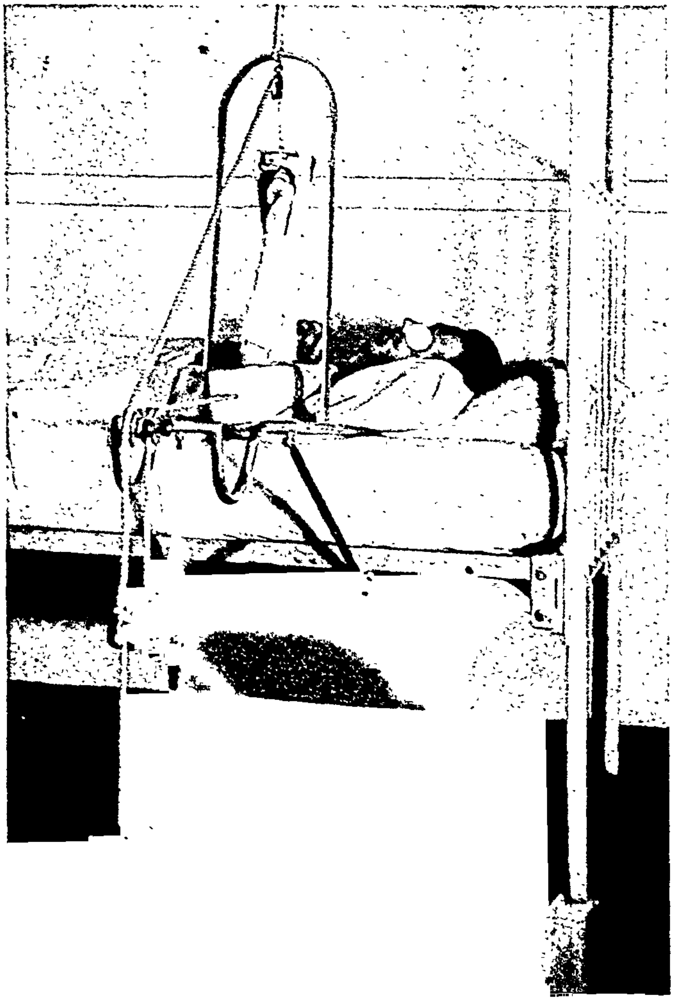

Fig. 3. Simultaneous traction of forearm and humerus for severe overriding of a fractured clavicle. Note the pillow beneath arm and shoulder and the blocks beneath the nearer legs of the bed frame which utilize the body weight for countertraction.

under both lateral legs of the bed frame to tip the bed. (Fig. 3.) Skeletal (Fig. 4) traction can be secured by pins through olecranon, metacarpals or acromion, or these in combination. To facilitate the smooth traction on the extended arm, a "dip" has been made in the terminal portion of the splint. This is most useful when adhesive traction with a spreader board is used, for the board can move freely along a plane slightly below that of the platform of the splint and thus the traction center of the board remains in line with the long axis of the forearm.

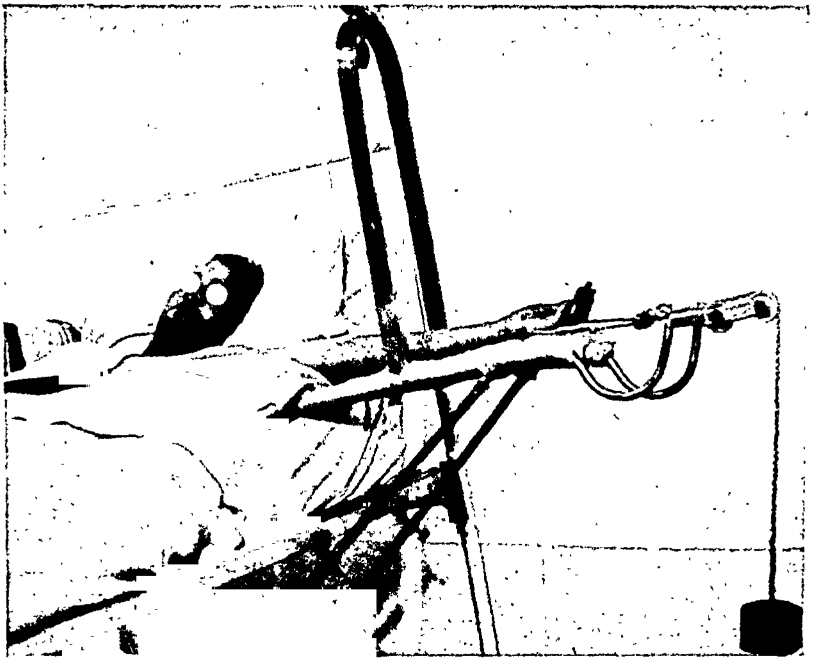

FIG. 4. Traction by means of a Kirschner wire through the metacarpals for a soft tissue contracture (post-traumatic) at the elbow. Here the counterpressure exerted by the splint on the olecranon is particularly helpful. Active flexion at the elbow is also used in this instance, using the traction weight for muscular opposition.

Bathing and turning a patient, with the lateral traction device in place, is quite easy but is facilitated if an overhead trapeze bar is available for the other hand to grasp.

The splint has a special usefulness for burns of hand and arm. Wet dressings can be used without soaking the patient's bed. Elevation of the burned member can be secured up to any normally desired level. Pressure dressings, with vaseline or other ointment gauze, can be splinted and supported very comfortably. By padding only parts of the splint, open areas can be supported free of any contact with underlying bed-clothing or other support; and in patients with circumferential burns of the arm over a fairly limited area, the additional comfort derived from lack of weight bearing is considerable. Small deep or even Thiersch or thick-split grafts can be treated by open methods and wet dressings with the arm thus supported. Any reasonable degree of elevation is securely maintained.

SUMMARY

Though ambulatory treatment of fractures of the upper extremity is usually the treatment of choice, bed treatment may be necessary and lateral traction required. Other conditions, such as burns, wounds, contractions and dislocations of the hand and arm may require elevation, splinting, or traction. No simple device for lateral traction is readily available in most hospitals and improvised methods may not prove altogether satisfactory. A lateral traction device designed by the author is herewith presented.

THE USE OF A RUBBER STAMP IN RECORDING DATA PERTINENT TO BREAST LESIONS

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THE accompanying breast stamp has been found to be of very definite help in clarifying the records of those patients with breast lesions who present themselves to the Barnard Free Skin and Cancer Hospital.

A written description of the position, size, and shape of a tumor, its attachment to the overlying skin or to the underlying fascia, whether or not there is a "pigskin" appearance in the skin, whether or not there is associated lymph node enlargement, all this and any other notable data should be recorded in every patient's chart. Altogether too frequently some pertinent points are not mentioned. A freshly written record may seem to be all inclusive at the time of recording but, when read at a later date, inadequacies are found. In assembling records for publication one is often impressed by the omission of necessary observations. We, therefore, believe that a diagram can be an important adjunct in both recording and preserving the clinical findings as they appeared at the time of the examination.

The use of a rubber stamp to produce anatomical illustrations is by no means new and the reproduction of an outline of the human breast and axilla by such a means is in itself a thing which has been done for years. We wish to make no claim as to the originality of this practice. We only offer a stamp which we think lends itself nicely to graphic illustration of most of the features which should be recorded as a part of the patient's case history.

Dr. William E. Leighton, chief of the Breast-Extremity Service, has long been aware of the failure of examiners to notice, or at least to record, the depth of a lesion within the breast substance. He suggested that a diagram should embrace both the profile and frontal views of the breast so that the lesion could be localized in depth as well as to a particular quadrant. This point was borne in mind when the stamp was being designed.

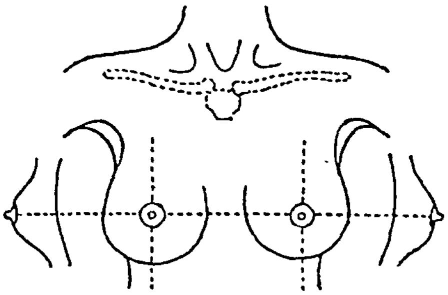

FIG. 1. The anterior thorax and the lower cervical regions are shown. Each breast is illustrated in frontal and profile views. The frontal view is divided into five segments (upper-outer, upper-inner, lower-outer, lower-inner and areolar). The profile view is divided into upper and lower halves. The axillary and supraclavicular fossae are shown.

It is a common practice to divide the breast into four quadrants such as upper-outer, lower-inner, etc. In addition to these a fifth subdivision, viz., the areolar area, is included. Since a certain number of intraductal papillomas are confined to a lactiferous sinus, it is wise to include such a subdivision as these could not be said to lie within one of the four quadrants.

A simple, diagrammatic sketch is the most useful medium for inking in one or more lesions. It is recognized that there are large, medium and small sized breasts and there is a pronounced variation in their shape. An outline was chosen which could be used effectively in the greatest number of cases. As both breasts are frequently involved, especially in cases of chronic cystic mastitis, it was decided to include both on one stamp. By including both breasts the problem of labeling left and right is obviated. The presence of palpable lymph nodes is a significant finding and should be depicted so the axillary and supraclavicular fossae are included.

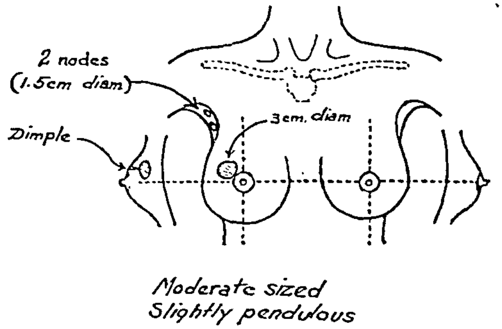

Fig. 2. Illustrating a mass (3 cm. in diameter) in the upper-outer quadrant of a moderate sized, slightly pendulous right breast, with axillary lymph node metastasis and dimpling of the skin.

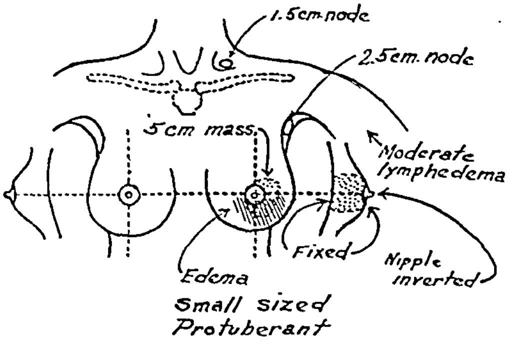

Fig. 3. Illustrating a large inoperable subareolar and adjacent quadrants mass (5 cm. in diameter) of the left breast. Other important data illustrated: inverted nipple, deep and superficial fixation of the mass, skin edema, axillary and supraclavicular metastatic lymph nodes, moderate lymphedema of the arm and the size and shape of the breast.

Figure 1 shows the evolved stamp. All features are included which were believed to be necessary. Figures 2 and 3 show the stamp as it might be used.

It is recognized that but little artistic ability is needed to ink in the apparent size and location of all masses. Fixation of a tumor to skin or to underlying tissue may be easily demonstrated by the use of the profile view. Dimpling of the skin may be indicated by drawing an arrow from the label to the point where it occurs. In the same way satellite tumor nodules and discharges from the nipple may be shown. Inflammatory zones, ulcerations and areas of edema (either localized "pigskin" of the breast or lymphedema of the arm) may be depicted by stippling, hatching, cross-hatching or, in the case of a swollen arm, the outline of the extremity may be drawn in. The presence of axillary or supraclavicular lymph nodes is recorded by making a dot in the correct location and indicating the clinical size by corresponding labels. (Stout believes that the clinical measurement of axillary lymph nodes is important, especially in evaluating the operability of the patient.) Below the illustration should be written terms descriptive of size and shape, i.e., small and atrophic or large and pendulous.

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Editorial

DIAGNOSTIC CURETTAGE*

BECAUSE of the present tendency, in some quarters, to advocate vaginal hysterectomy in all cases of indefinite uterine bleeding, regardless of diagnostic curettage, and as April is the cancer month in the United States, it seems to me the consideration of the subject is very timely; moreover it is of general interest.

In 1914, I read a paper before the Obstetric Section of the New York Academy of Medicine entitled "Complete Removal of Adenocarcinoma of the Uterus by Exploratory Curettage" and described three personal cases. The fact that early adenocarcinoma can be removed completely by curettage is of no extraordinary significance; but because the cases were the first to be recorded in all of the American and British literature, I was prompted out of a pioneering spirit and professional vanity to report them. However, eighteen cases were reported in Germany and Austria between the years 1888 and 1913. After the publication of my paper in 1915, similar cases were recorded in the United States and in nearly all civilized countries.

These cases were not offered by me as examples of cure of corporeal carcinoma by curettage, as was misinterpreted by some writers. On the contrary, immediate total extirpation of the uterus was definitely urged in all cases in which microscopy of the curettings showed malignancy, including the cases in which a second curettage was done for some reason or other and showed that the lesion had been entirely removed by the first curettage.

However, while I was preparing the paper it occurred to me that it would be a great boon to womankind if carcinoma of the body of the uterus could be detected in its incipiency, and that in diagnostic curettage we had the readily available means of doing it. The paper was accordingly devoted to an earnest and urgent appeal for the general adoption of diagnostic curettage as a routine measure in all cases of doubtful uterine bleeding; and this applies especially to women approaching the menopause and to those beyond it.

Here I would like to sound a word of warning: It must not be taken for granted that the uterine bleeding in menopausal cases is due to the administration of estogens without confirmation by a diagnostic curettage.

I confess that this appeal did meet with some opposition then. Among some of the objections was the possibility of stirring up something by the curette. This is not in accord with my experience. I have never met any untoward effect from an intelligent use of the curette, and it has been my practice for many years to perform a preliminary curettage to all hysterectomies in which there is the slightest doubt as to the benign condition. If the curettings appear negative on gross inspection, a supravaginal hysterectomy is performed immediately; but if the gross inspection of them is positive or on the border line, the indicated total hysterectomy is postponed until the diagnosis is confirmed by the microscope. There is a twofold reason for this procedure: First to determine in advance between the choice of supravaginal and total hysterectomy, because the difference between them in my opinion is that between a minor and major operation; and the other reason is to avoid a most disagreeable surprise and embarrassment both to the surgeon and relatives on discovering malignancy in the uterus after it had been extirpated.

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* Read at a meeting of The Clinical Society of the New York Polyclinic Medical School and Hospital, May 1, 1944.

Another and most conclusive answer to the above objection can be found in the fact that in some of the cases reported here and abroad, the uterus was not extirpated because a second curettage showed the lesion had been completely removed by the first curettage and the patients remained well for some time.

"A Plea for Early Diagnostic Curettage and Routine Microscopy of Curettings for the Detection of Adenocarcinoma of the Uterus" was the title of a paper I read at a symposium on cancer before the New York County Medical Society in 1927. This paper was published in February 1928, and, I believe, met with general favor. This belief was strengthened when The American Health Association invited me to give a talk on "What Women Should Know About Cancer," over Radio Station WJZ, June 5, 1929, and I dwelt particularly on the advantages and benefits of a diagnostic curettage.

Diagnostic curettage still is and will remain the most reliable and effective means available of detecting adenocarcinoma, especially in its earliest stages and, in my opinion, will never be replaced by the hit or miss, mostly miss, expedient of a prophylactic vaginal hysterectomy, which in many instances, will add to the list of operations unnecessarily performed.

Curettage for diagnostic purposes is of no value unless it is performed with particular care and special attention is given to the shape of the uterine cavity. The uterine cavity is not tubular but triangular, flattened before backward, with its walls closely approximated and joined at sharp angles on either side. At each superior angle is a funnel-shaped cavity at the bottom of which is the orifice of the Fallopian tubes, and unless the curette covers the entire surface of the cavity in a systematic and thorough manner, an early lesion may be overlooked. However, as the curettage is done primarily for diagnostic purposes and not as a curative measure, it should be discontinued in the later stages of the disease, as soon as sufficient material is procured for microscopic examination.

It is needless to say that the microscopy must be done by competent pathologists. While frozen sections may be relied on in tests for cancer in other parts of the body, it must never be used in the examination of uterine curettings; and here I desire to stress the fact that only paraffin sections of all material removed by the currette should invariably be used for microscopic examination.

I will cite a case showing the importance and value of the procedure and also of the above precautions: Some time ago a doctor referred a patient to me whose history and findings were suspicious of malignancy. I advised a diagnostic curettage which I performed at the Polyclinic Hospital. The doctor, because of his anxiety to learn the result had a frozen section examined against my advice, which proved to be negative and he so informed the patient. She thereupon decided to leave the hospital. With some difficulty I persuaded her to stay until paraffin sections could be examined which proved positive for adenocarcinoma. I performed a total hysterectomy and she has been well since.

The laboratory report follows: "The microscopic examination of the curettings showed adenocarcinoma of the uterus, which is probably not invasive, and should the uterus be removed may be found for the most part to have been curetted away. On gross inspection there is found a small cellular area in one corner of the uterus which is apparently a focus of adenocarcinoma. This on microscopic examination showed adenocarcinomatous growth corresponding to that found in the curettings removed previously." The slides were sent to Dr. Ewing for confirmation and I quote from his report: "In the section of uterus of X I do not find any tendency to infiltration of the muscularis by the adenocarcinoma and on that account I do not think postoperative *x*-ray treatment is indicated."

This case, one of a number of similar cases, is especially interesting as an illuminating example of the great value of diagnostic curettage and the importance of the precepts stressed above. If this patient had left the hospital without submitting to a hysterectomy and would have decided on another curettage by another surgeon or even by me before undergoing operation, in all probability, *because of the location of the lesion*, no trace of malignancy would have been found in the second curettage, and the proper treatment might not have been instituted. This actually happened in one of the three cases I reported in my first paper.

There is no room in this country for an advanced case of adenocarcinoma of the body of the uterus. Every such case records an instance of neglect on the part of the patient, a wrong diagnosis or a diagnosis made too late, and presents an example of a woman suffering from cancer who has been denied the benefits and the advantages of early diagnosis and the hope of cure that early treatment affords. I very much regret to say there is still room for the necessity of reminding the public and the profession that diagnostic curettage is absolutely and positively a life saving procedure.

Louis J. Ladin, m.d.

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Original Articles

TUMORS OF THE UROGENITAL TRACT IN THE YOUNG*

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MALIGNANT neoplastic disease is so often associated with the older age group of patients that at times the fact that such disease not infrequently exists in infants and children is overlooked, and its importance is disregarded. The successful therapy of all malignancies depends upon early recognition; and because this early diagnosis is so imperative, it is the purpose of this presentation to recapitulate the more usual types of neoplasms of the genitourinary tract which are encountered in children, and to focus the attention of the physician on the possibility of the existence of neoplastic disease in the young. Despite a comparatively low incidence of such disease, these tumors grow so rapidly, produce so few prominent symptoms until very far advanced, and result in such a high mortality, that the problem of these lesions becomes one of very grave import.

Cases of neoplasms arising in the urogenital tract of children admitted to the New York Post-Graduate Hospital during the past two decades have been analyzed. This is a general hospital caring for cases of acute disease, with no particularly special emphasis on malignant disease or pediatrics; consequently it is believed that the cases observed are representative of those which may be found in the usual active general hospital anywhere and a discussion of these cases may bring to the fore the likelihood of the existence of these tumors in children and stress the need for early recognition.

TABLE I
CASES OF MALIGNANT TUMORS IN CHILDREN

Renal tumors		32
Adenomyosarcoma (Wilms tumors)	31	
Papillary carcinoma of kidney	1	
Tumors of the adrenal		3
Tumors of bladder		4
Tumors of testis (teratomas)		4
		43

NEOPLASMS OF THE KIDNEY

These are the most common neoplasms of the urinary tract and of the abdomen in the young, and comprise about one-fifth of all tumors in children, second in frequency only to those of the eye. Moreover, almost all of these renal tumors are of the Wilms type. Of the thirty-two malignant neoplasms of the kidney observed, thirty-one were Wilms tumors; one tumor diagnosed preoperatively as a Wilms tumor in a boy six and one-half years of age, was found, on pathological examination, to be a papillary carcinoma of the kidney. Although hypernephromas and adenocarcinomas of the kidney in children have been described, they are exceedingly rare, and we have not observed any of these lesions.

Pathology of Wilms Tumor. (Figs. 1 and 2.) In 1899, Wilms defined the tumor which now bears his name. It has variously been designated as congenital mixed tumor, leiomyosarcoma, rhabdosarcoma, and teratoma, but at present the more descriptive term of embryonal adenomyosarcoma is generally accepted. The origin of this type of tumor has not been definitely settled, but because of the varied histological features present, i.e., several component tissues, and the several degrees of differentiation of the component cells, the tumors must be considered embryonal, arising in the course of the fetal development of the kidney. Several theories have been advanced to explain the formation of the tumor: (1) Persistence of Wolffian body tissue among the cells of the developing kidney; the tumor would have its origin in this remnant of the Wolffian body. (2) Aberrant cells of the myotome and sclerotome within the nephrotome serve as a point of origin of the tumor; the mixed character of the tumor would be explained by these different formative constituents. (3) Embryonal tissue of true kidney persists, later becoming metamorphosed into varied cellular structures. This theory denies the origin of the tumor from inclusions of extrarenal bodies, which the other two theories proclaim, and is favored by Ewing.[7]

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* From the Department of Urology, New York Post-Graduate Medical School and Hospital, Columbia University, New York City.

The tumor may be of varying proportion, but the majority are large and give rise to clinical recognition by their size. Characteristically, the tumor grows rapidly and may become enormous. It is generally solid, grayish-white in color and encapsulated in a layer of tough connective tissue which separates it from the kidney proper, but the renal capsule is found to blend with this encapsulating tumor layer. Hemorrhagic or softened areas are not uncommon, and the lower pole of the kidney is the most frequent site of tumor origin. Since the tumor grows by expansion rather than infiltration, the kidney itself and the pelvis are found to be compressed and distorted. This tendency to expand, rather than to infiltrate, and the characteristic encapsulation are probably the reason for the paucity of urinary signs and symptoms. The pelvis is not invaded until the tumor ruptures through its capsule late in the course of development and, as a result, hematuria is not noted in a majority of the cases.

The tumor is generally unilateral, but cases of bilateral tumor have been reported. It displaces the colon by its growth and occasionally invades it, and, on the right side, may obstruct the duodenum. Neither side is, however, affected any more often than the other. Metastasis is by the blood stream and spread is found in the liver, lungs and brain. Approximately one-fourth of our cases had demonstrable metastases when first seen.

Age. In this series, sex was equally divided (fifteen girls, sixteen boys) and the average age of the patient was three and one-fourth years, the age range extending from the youngest child of five months to one girl of sixteen years. This age incidence is in agreement with reports in the literature, tumors arising in patients beyond the age of ten only in rare instances.

Symptoms. Wilms tumor has been called a disease of signs rather than symptoms. The presenting complaint in the vast majority of cases is that of a gradual enlargement of the abdomen, thus leading to the discovery of a tumor mass. Hematuria, though stated by Campbell[3] to be present in 15 per cent of the cases, has been found to be present in our series in only 3 per cent, which is in agreement with the findings of Dean.[5] This low incidence of hematuria is in distinct contrast to the frequency of hematuria in malignant tumors of the kidney in the adult. No doubt this is due to the fact that the hypernephroma of the adult is invasive and ulcerates through into the pelvis of the kidney, whence red blood cells thus enter the drainage system and are found in the urine. On the other hand, as has been stated, the Wilms tumor is enclosed within a capsule until late in the progress of the growth. When the size of the tumor becomes so large as to produce pressure, one may note nausea, vomiting, constipation, because of compression of the abdominal viscera, and dyspnea due to the elevated diaphragm. Jaundice may supervene. Terminal stages show extreme cachexia, ascites and anemia. Pain does not occur early. Fever, the mechanism of which is obscure and which is also found in children who have other types of malignant neoplasms such as lymphosarcoma, is present in about one-half of the cases.

Fig. 1.

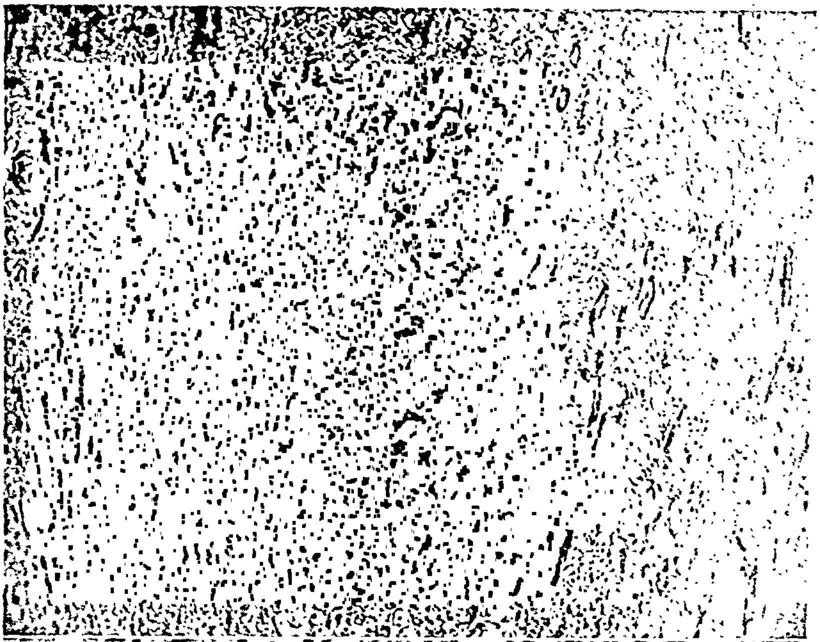

Fig. 2.

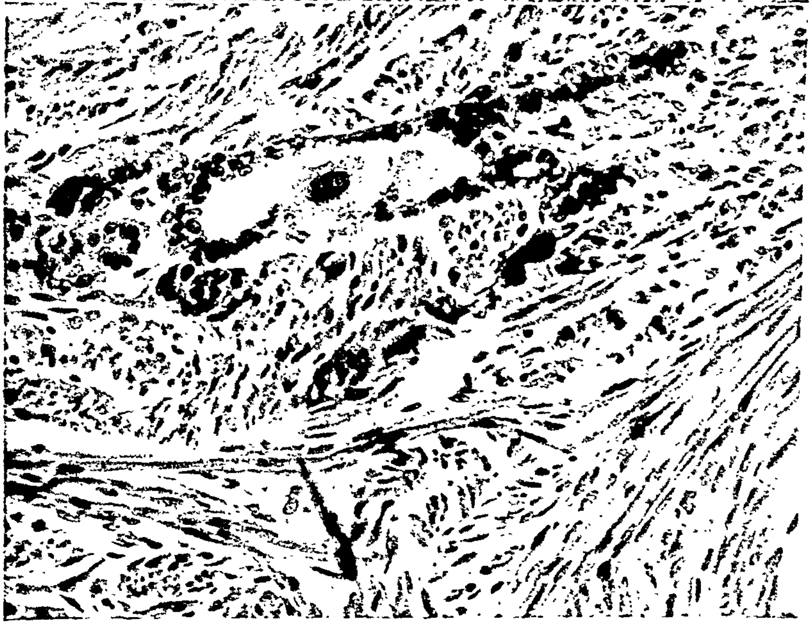

Fig. 1. Section of Wilms tumor. Low power view showing kidney tissue on the left, an intermediate zone of compressed tissue and inflammatory cells, and tumor on the right. × 167.

Fig. 2. High power magnification showing mixed elements of the Wilms tumor: kidney tubules, smooth muscle fibers and striated muscle fibers. × 635.

Diagnosis. The mass, found on palpation to be smooth in most instances, has a mobility depending on its size. It is fairly characteristic to find that the mass has grown downward, forward and across the abdomen toward the opposite side rather than to bulge in the flank as is usual with adult kidney tumors. (Figs. 3 and 4.)

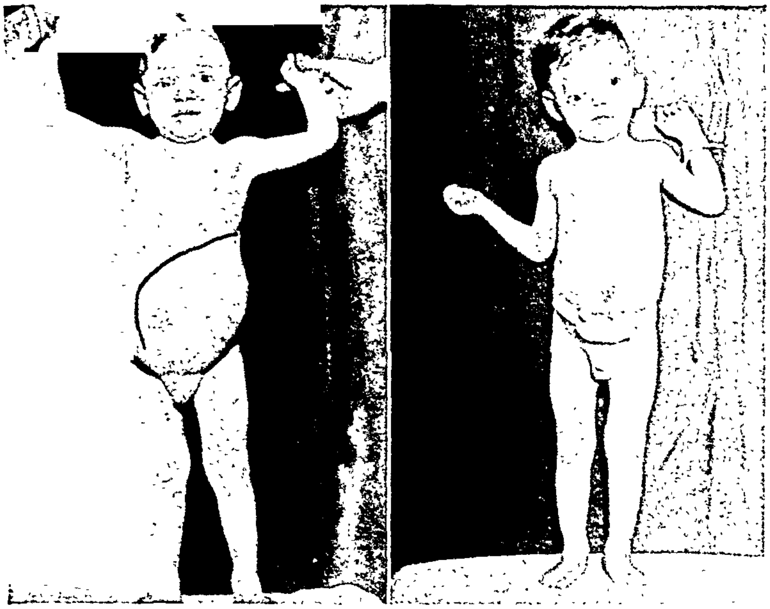

Fig. 3. Fig. 4.

Fig. 3. Two year old child with a large Wilms tumor. The pronounced abdominal enlargement due to tumor mass is readily seen. The extent of the mass is outlined on the abdominal skin.

Fig. 4. Same child after operation. The abdomen is now normal in size, but the proptosis of the eye, due to retrobulbar metastasis, is very evident. This child died approximately ten months after surgical removal of the mass.

Diagnosis can be made by intravenous urography which shows not only disdisplacement of the affected kidney and distortion of the pelvis, but also delineates the opposite kidney and reveals whether it is functionally sound. Where intravenous urography does not suffice, retrograde pyelographic studies may be necessary and should not be delayed. Age is no contraindication to retrograde urography for the armamentarium of the present-day urologist enables him to examine completely any child, no matter how tender the age of the patient. (Figs. 4 and 5.)

Differential diagnosis includes the following: (1) Suprarenal tumors (these are discussed below); (2) cystic kidneys—solitary cyst or polycystic kidney must be considered in diagnosis of the abdominal mass. Our records include the case of an infant girl operated upon at the age of twenty-three days for a huge solitary cyst of the kidney which prior to operation had been suspected of being a Wilms tumor. (3) Hydronephrosis produced by aberrant vessels or congenital strictures of the ureter or to bands obstructing the ureter may be differentiated by urographic studies. (4) Ovarian tumor and hepatic tumor may have to be excluded in the differential diagnosis, but these conditions are very rare in children. (5) Splenomegaly should be considered; blood studies will help in the differentiation of this condition. (5) Sarcoma of the retroperitoneal or mesenteric nodes—these masses generally are irregular and nodular, and involvement of other lymph nodes will aid in the diagnostic exclusion of these diseases.

Aspiration biopsy has been advocated by some, but this is mentioned here only to be condemned. Similarly, exploratory operation for diagnosis appears to us to be unnecessary as the diagnosis should be made *preoperatively* by urologic procedures.

Treatment. This should be a combination of x-ray therapy and surgery. Preoperative radiation serves in many cases to reduce the mass in size and to increase its mobility. Although the details of the roentgen treatment should be determined by the *x*-ray therapist, one must stress the importance of radiation through several portals in fractionated doses rather than by means of a single massive dose, with the protection of vital organs, especially the liver and spleen. However, though these precautions may be taken, diarrhea, nausea, vomiting and anemia generally supervene. Vitamin B complex aids in reducing the intensity of the gastrointestinal symptoms and it also may be found necessary to give multiple transfusions to overcome both the anemia and the leukopenia which may be the result of *x*-ray treatment.

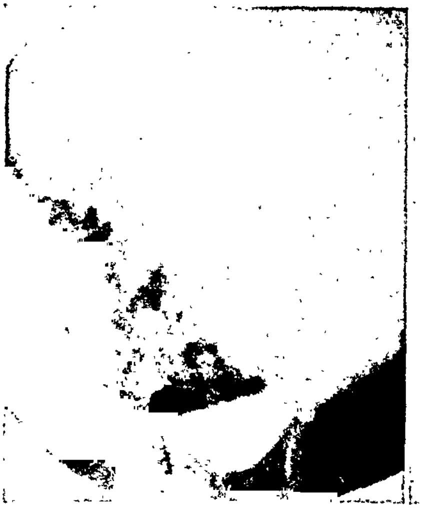

Fig. 5. Urogram reveals a homogenous mass density on the left and upward displacement of the left kidney. There is delineation of a normal right kidney.

Fig. 6. Close-up of the area of the left upward displaced kidney in the same patient as in Figure 5. The arrow points to the distorted renal pelvis as outlined by the intravenously administered urographic dye.

Approximately five to six weeks following the termination of radiation treatment is probably the optimum time for surgical removal of the mass. We definitely favor the transperitoneal approach, exposure of the mass is simpler, and the renal vascular pedicle can be clamped off early in the procedure before complete mobilization of the mass. This tends to obviate or preclude the dissemination of tumor thrombi which may be in the renal veins, and which might be torn loose while manipulating the tumor during its mobilization, if the iliocostal approach is employed. Liberal transfusion is indicated. Postoperative radiation should also be given about one month after the nephrectomy. Where metastasis is present or found at a later date, intensive radiation should also be given to the involved sites.

Although surgical success is rare, removal of the mass should be urged in every case. We cannot agree with the statement of one author who advised that "All Wilms tumors are best treated with radiation alone."[5] Nephrectomy appears to be essential, for irradiation *per se* cannot be depended upon to destroy all of the malignant cells.

Results. These are uniformly recognized to be poor. The average life expectancy following initial discovery of the tumor is said to be about eight months.[5] Analysis of our thirty-one cases are shown in Table II.

Though long survivals postoperatively have been reported,[13,17] the figure of ultimate mortality is about 90 to 95 per cent. This poor outlook can be changed only by early recognition of the disease. Even then, we must point out the high operative [illegible] mortality, which has not [illegible] with our recent advances in surgery. [illegible] Walker, [illegible] reported the immediate mortality [illegible] of Wilms' tumor, stated that [illegible] per cent [illegible] per cent. [illegible]

[illegible]

[illegible]

Embryologically, the adrenal is derived from two germ layers: the mesoblast gives rise to the cortex, and the ectoderm, the sympathetic nervous system, to the medulla. Most of the tumors of children which are called "retroperitoneal sarcomas" are actually neuroblastomas and are derived from the adrenal medulla. It should also be pointed out that malignant tumors of the medulla are almost exclusively found in childhood. (Cortical tumors, which are very unusual and always produce sexual developmental changes, are not considered here.) These neuroblastomas (neurocyto- [illegible] may occur in early life; we have seen three cases, two aged one and one-half years and one three and one-half years old. The mass grows rapidly, protrudes [illegible] in the flank, and may have to be differentiated from renal tumor. It causes [illegible] downward displacement of the kidney, with less distortion of the pelvis than is seen with the Wilms tumor; [illegible] difficult from [illegible] and the true character [illegible] only at the time of surgical exploration. [illegible] metastases [illegible] present when the [illegible] apparent. In other cases, the [illegible] produce the [illegible] and the [illegible] In our three cases, metastases were already widespread at the time the children were first seen. These metastases [illegible] two forms, and [illegible] therefore [illegible] metastases to the liver [illegible] with [illegible] (Pepper type), the second or Hutchison type of metastasis is characterized by early orbital and skeletal [illegible] with [illegible] swelling of bones [illegible] of the skull, proptosis of the eye and [illegible] In either type, the course is rapidly fatal and death occurs within a few months.

Pathologically, the neuroblastoma may show embryonal nerve cells and fibers, the former frequently are arranged in round clusters called rosettes. The metastases are similar to the primary growth.

Unfortunately, treatment in these cases is hampered by the fact that spread has so frequently occurred before medical aid is sought. Where metastasis is present, surgery is contraindicated and resort may be had to radiation therapy. In the infrequent case in which primary operability is present, it may be possible to shell out the tumor *in toto* or else extensive dissection may be required. The outlook, however, is extremely poor, and of the cases reported in the literature, the mortality is almost 100 per cent.

TUMORS OF THE URETER

Primary tumors of the ureter in children are practically non-existent; we have not seen any such cases. Occasionally, an ureteral tumor secondary to a primary renal growth may be found.

TUMORS OF THE BLADDER

Vesical tumors are quite unusual in children; of four cases observed here, two were sarcomas, one showed a small papilloma of the bladder while the fourth had multiple papillomas. The inclusion of the latter two cases is done because, though microscopic examination may show them to be benign, all are *potentially malignant* if only in their tendency to local recurrence.

The vast majority of bladder tumors in children, however, are sarcomatous and are generally very far advanced when first brought to the physician's attention. Symptoms result from vesical irritation and urinary obstruction, producing frequency, dysuria, urgency, straining on voiding and incontinence. With subsequent ulceration of the tumor, pyuria and hematuria are noted. When diagnosis is made, unfortunately the tumor is widespread in the bladder and the general condition of the patient is too poor to permit radical surgery; consequently one must resort to the palliative measure of suprapubic drainage. Benign tumors respond to cystoscopic electrofulgeration or resection. In the event of early discovery of a vesical sarcoma, bilateral transplantation of the ureters to the bowel followed by cystectomy might be employed. Though *x*-ray radiation has been used in cases of these malignant tumors, such treatment is apparently of little benefit.

TUMORS OF THE PROSTATE

These are quite rare and are similar in nature to the tumors of the bladder; they are predominately mesodermal in origin and are sarcomatous; often the true origin of the tumor (i.e., prostate or bladder) cannot be accurately determined because of widespread local extension at the time the case is brought to the physician's attention. Symptoms are due, as in vesical tumor, to obstruction of the urinary outlet, and only palliative therapy can be employed. Benign tumors of the prostate are exceptionally rare, but one such was encountered in a boy of fifteen who had a pedunculated tumor of the left lobe of the prostate. The tumor protruded into the posterior urethra and was easily removed by the transurethral route.

TUMORS OF URETHRA AND PENIS

Primary malignancies of the urethra practically never occur in children. However, papillomas are not infrequent in boys nor is urethral caruncle in girls very unusual. Urethral irritation generally produces enuresis and all such children should be examined to rule out the presence of these lesions. Electroresection will cure the papillomas of the deep urethra, but for the caruncles, complete excision is advised. We have had two patients who were completely relieved of urinary symptoms of removal of these growths.

Though we have several instances of cysts of the prepuce and meatus in boys, these are not truly new growths. Carcinoma of the penis does not occur in boys; but where the prepuce is tight and irritation results, the glans and prepuce may be the site of precancerous changes in early childhood. The child can of course be protected from such an eventuality by circumcision shortly after birth.

TUMORS OF THE SPERMATIC CORD

Malignant growths of the spermatic cord are exceptionally rare; we have seen none, but our cases include a number of lipomas and fibrolipomas of the cord, which were coincidental findings at operation for inguinal hernia.

TESTICULAR TUMORS

It is well known that malignant growths of the testis generally arise in the younger adult, but it must not be forgotten that such neoplasms are also seen on occasion in infancy and childhood. Two cases of tumor of the testicle have been seen at our hospital occurring in boys aged one year and eight months, and twelve and one half years, respectively; both were diagnosed on pathologic examination as teratomas. Seminoma is practically unknown in the young.

Any intrascrotal growth or testicular enlargement in boys should be looked upon as a malignant growth until definitely proved not to be so. Such a viewpoint must be held because very few ailments produce enlargement of the testicle in children, and because metastasis from a truly malignant growth of the testis occurs so early; hence dissemination is so wide that procrastination and delay in diagnosis utterly destroys the relatively few chances of therapeutic success. The tumor is congenital in origin, and Ewing's theory[7] is that the growth arises from totipotent sex cells, where there is predominance of a single tissue or structure; such an occurrence probably results from unilateral development of the potentially tridermal cells. Most of the tumors consist of anaplastic embryonal cells, but adult structures with advanced cellular differentiation frequently occur. Metastasis is at first by lymphatic extension to the abdominal nodes where these enlarged nodes can at times be palpated; later, hematogenous spread occurs as well and the lungs are frequent sites of metastatic implants.

Diagnosis should be made by palpation of a hard enlarged scrotal organ. A palpable abdominal mass representing metastatic growth should be sought and also x-ray examination of the chest should be made to eliminate pulmonary involvement. Aspiration of the testicular growth for purposes of biopsy is not recommended. An important diagnostic aid is the Aschheim-Zondek test as these tumors generally cause an increase in the urinary output of the follicle-stimulating hormone of the anterior pituitary body. When the tumor is removed, the test becomes negative only to become positive again should recurrence be present. This test then is valuable both in the diagnosis of the disease and the subsequent follow-up of the patient.

Treatment of the patients before spread has occurred should include x-ray radiation therapy, given preoperatively followed by orchiectomy. It is not believed that the radical operation with extensive dissection and removal of the inguinal and abdominal retroperitoneal nodes offers much more likelihood of greater success than does the orchiectomy for the reason that it is highly uncertain that all of the tumor cells can be removed where metastasis has occurred. In those cases in which lymphatic or hematogenous spread is present, only radiation therapy to the primary mass as well as to the secondary implants is advised.

CONCLUSIONS

1. Though malignant disease is primarily a disease of the adult, its occurrence in the young should not be overlooked, for only in its early recognition lies the possibility of successful therapy.

2. The most frequent tumor of the urogenital tract in children is Wilms tumor of the kidney. Diagnosis can be made in most instances by urographic measures. Preoperative and postoperative x-ray therapy should be given. It is held that the transperitoneal approach for removal of the kidney should be employed.

3. Less frequent in occurrence are tumors of the adrenal gland, bladder, prostate and testis, but the possibility of their existence, even in the very young, must

be emphasized and thorough search made for signs of these highly malignant growths.

4. Early diagnosis of malignant disease of the genitourinary tract in children is a *sine qua non* of successful therapy. In all cases, resort in treatment should be to *x*-ray radiation *and* surgery combined; radiation therapy should not be employed alone except in those cases in which widespread metastases are present.

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HETEROGENOUS SKIN GRAFTS BY THE COAGULUM CONTACT METHOD

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I WAS impressed with the principle propounded, when I first read Dr. Sano's article in the *American Journal of Surgery*, July, 1943. She based her concept upon the same principles which were successful in growing cells outside of the body in tissue culture, and wondered whether it might not be applicable to skin grafting by providing, physiologically, adhesion of the graft to its bed through the use of plasma.

Dr. Sano quotes R. C. Parker: "In tissue culture, growth is obtained by supplying (1) a suitable surface for the cells to grow on through the use of coagulated plasma, (2) adequate nutrition through a medium composed of embryonic tissue extract and a buffered salt solution (Tyrodes). The most satisfactory cell growth is obtained in tissue culture by the use of homologus plasma and tissue extract. The plasma is heparanized when obtained, to prevent its coagulation until it comes in contact with the tissue extract and salt mixture at the time of planting the culture. With such contact, the fibrin is precipitated and a delicate clot is formed, which serves to fix the tiny fragment of tissue and thus permits cell growth to take place. In such cultures, it has been shown repeatedly that fibrin plastic proliferation normally begins within a matter of a few hours."

Dr. Sano also states in her article that in ten animal experiments, the results were entirely successful.

In view of these facts, I became very much enthused. However, not having access to animal experimentation, and knowing little or nothing about tissue culture and growth to hazard clinical investigation upon the basis of that report, the subject was actively dispelled from my mind until another of Dr. Sano's articles appeared in the November, 1943, issue of *Surgery, Gynecology and Obstetrics*. In this report she presented the clinical application of the coagulation method of skin grafting and described the technic used and end results in ten cases.

My previous mental enthusiasm was revied with its resultant manifestation in the clinical application of the method to several cases which subsequently presented themselves.

According to Dr. Sano's article, she was first stimulated to her investigation in the attempt to find some means of eliminating the arduous manner of skin grafting which she experienced while assisting a surgeon in that type of work. I was encouraged by her brilliant achievement and the logic of the procedure.

Fomon states; "Histologic changes of the application of a graft to the donor area is divided into three stages: (1) Stage of plasmic circulation. (2) Stage of vascularization. (3) Stage of organic union." As Fomon so aptly describes it: "Within a few minutes after transplantation, the blood vessels dilate, the dilation being followed by an exudation of plasma. The plasma soon becomes converted into fibrin, which not only serves to anchor the graft to its bed, but also forms a matrix for the plasma and lymph circulation, and a scaffolding for the budding of the endothelial cells of the blood vessels destined to nourish the graft."

The coagulation contact method merely replaced the stages through which the tissues must pass through the normal response in order to arrive at the same goal.

This saves a period of twenty-four to forty-eight hours, so that the graft has an advanced start of fixing itself to the recipient area.

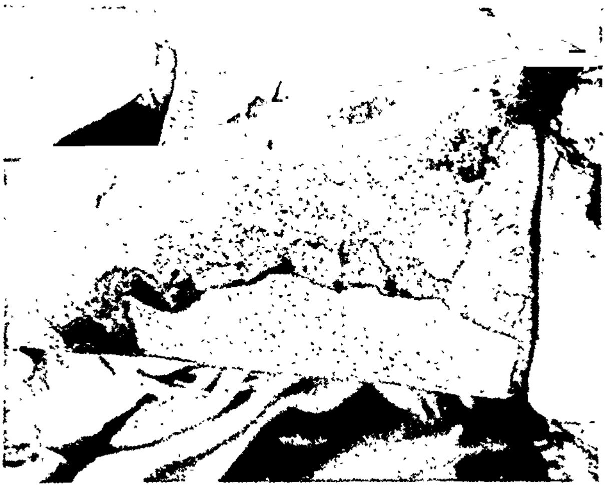

Fig. 1. Case vii. Shows a heterogenous graft on the thigh. This graft is in the third week. The graft was taken with the dermatome and measures about thirty-two square inches. The thickness was .014 of an inch. The graft is placed in the center of a granulating area. Dressings were applied to the granulation tissue around the graft only. In this instance the graft only was heterogenous, the plasma and cell extract being taken from the patient.

Heretofore, when a graft was applied, a series of the usual type of interrupted or continuous sutures were inserted to keep the graft in place and to approximate its margins. Next the problem of pressure was to be considered. This was also a source of worry because the amount of pressure to apply was at the best a matter of guesswork.

F. Smith has estimated the ideal pressure for full thickness grafts to be 30 mm. to the square inch. Various ingenious methods have been advocated to maintain this pressure, but in the final analysis, no standard method is available. Every surgeon develops a technic augmented by his experience and surgical judgment.

Balloons, various types of sea sponges, marine sponges, rubber sponges, mechanics waste and many layers of gauze elastic and compression bandages have been and are being used to produce that certain amount of pressure on the graft. Then stay sutures were inserted to fix these various materials in place and to immobilize the graft.

An insufficient amount of pressure permitted the accumulation of serum and sometimes blood with the resultant loss of the graft or the predisposition to infection. Too much pressure prevented the normal amount of exudation of plasma and the subsequent budding of the capillaries into the graft.

The sutures which were inserted were conducive to bleeding, subject to infection, and if permitted to stay too long, produced stitch marks which resulted in a poor cosmetic result. The stay sutures pulled, thus producing pain, and were also subject to infection.

By the use of the coagulum contact method, these hazards are eliminated. In addition, shock, which in its own right is a very potent factor to be considered, is lessened by shortening the duration of the operative procedure and by lessening the quantity of anesthetic used.

The cases reported by Dr. Sano were representative. The results generally speaking were excellent. All the cases reported were done with autogenous grafts and homologus plasma and cell extract.

I tried several cases, using the same technic and the results were so satisfactory, that I decided to vary the type of graft. When the heterogenous iso graft with autogenous plasma and cell extract was used the result was excellent. A heterogenous iso-graft with homologus plasma and cell extract also gave an excellent result. Following the successful takes with these grafts, I was curious to see whether a heterogenous iso-graft with a stock plasma and cell extract would likewise be successful. This was done also with excellent results. These procedures were carried out on actual cases which represented the types of conditions in which such grafts should be used.

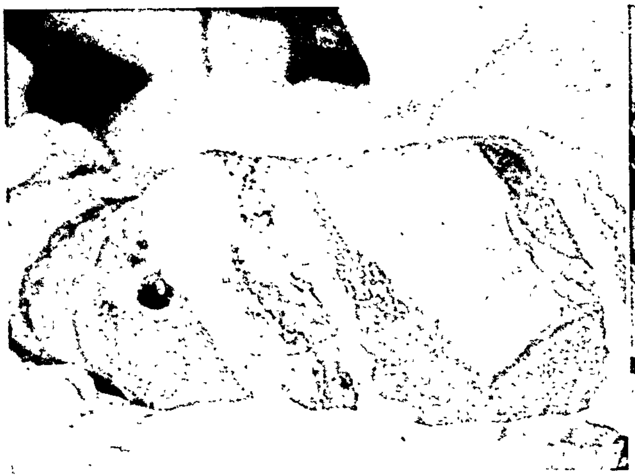

Fig. 2. Case viii. Heterogenous graft from the father of the child. In this case the plasma and cell extract were also taken from the father. Graft is two weeks old and shows a good take over the buttocks and pelvis. The total amount of skin was approximately sixty four square inches. One of the grafts was split to surround some scar tissue. The graft was .016 of an inch in thickness. The surrounding area shows infected granulations.

The heterogenous iso-graft with the patient's own plasma and cell extract was first used on a twelve-year old girl, who had been burned completely on one side of the body, including the entire upper and lower extremity on the right side. The child was neglected for about four months before any kind of treatment was instigated. Various types of burn treatments were given with no visible results. The child was emaciated, had a blood dyscrasia and septic hyperpyrexia. Profuse bleeding occurred from the burned area even when redressings were not done. The granulation tissue was infected.

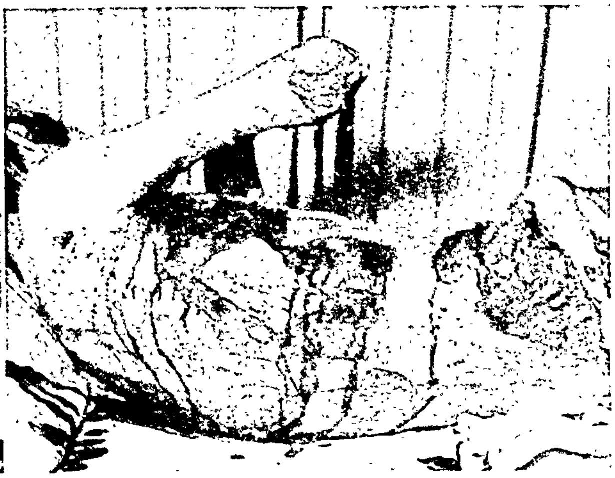

Fig. 3. Case ix. Heterogenous graft to chest wall of three weeks' duration. This graft is placed more toward the posterolateral side. In this instance, a non-member of the family was used for the skin and an entirely different blood was used to make the plasma and cell extract. A good take. Only about twenty-four square inches of skin were used because of the uncertainty of the final results. There is a slight wrinkling in the lower most angle. This is due to the weight of the first sulfathiazole dressing which pulled the graft against the dressing. Subsequent dressings were not applied to the graft. Only the surrounding granulating tissues were dressed. Even with thickly applied ointment dressings, there was bleeding when the dressings were changed as can be noted.

The girl was not in physical condition for grafting. She had no skin to give. A heterogenous graft was considered, but there was a question whether she could stand shock associated with that. The father of the girl was consulted and fully advised about Dr. Sano's procedure and the possibility of failure was explained, and that even with a good take it was only a palliative measure. He consented to the procedure and volunteered to be the donor. The results of the grafting were excellent; the take was perfect. The little girl responded well and appeared to fare better. Only one drum of skin was used, about 10 cm. by 15 cm. The only objectionable feature was the fact that we had to take blood from the patient and this she resented, because of the pain and I was hesitant to take even 20 cc. of blood for another graft.

The father was again consulted and at this time I decided to use the plasma and cell extract, as well as the skin, from the father. By doing this the child did not have to go through any more inconvenience than an ordinary redressing.

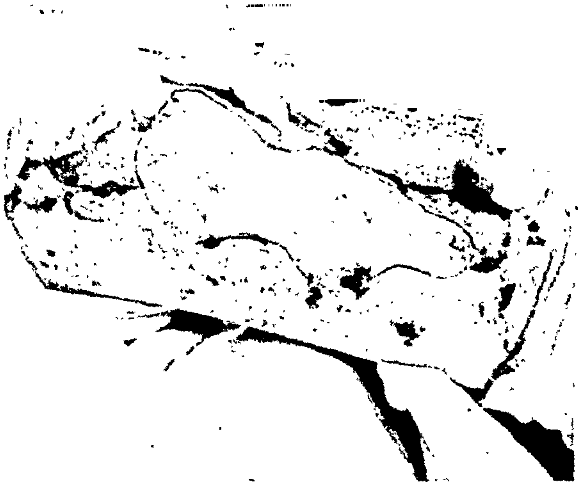

Fig. 4. Shows photograph of the area of the thigh taken two days after the removal of a covering composed of fibrous tissue and elastic elements. This is the appearance five months after the first application of heterogenous graft as described in Case VII.

The procedure was done and two drums full of skin, the same size as the first one, were taken and applied to the pelvis and buttock. These grafts also showed a complete take.

However, the girl was not even one-half covered. The father could not donate any more skin and the mother was unwilling to do so and we were anxious to continue the improvement as rapidly as possible. It was then decided to try a heterogenous iso-graft with a stock blood plasma and cell extract. The results of this were also excellent.

In extensive burns, the heterogenous graft with the stock plasma or homologus plasma should be an excellent treatment. This will be done as soon as the cases present themselves. If early grafting can be done, the mortality rate will be decreased, the number of shock cases will be lessened and deformities reduced to a minimum.

I am reporting the following cases of skin grafting by the coagulum contact method, in order to further substantiate the claims of the results obtained by Dr. Machfeld E. Sano:

Case I. A female, age twenty-eight years, had received a third degree burn on June 10, 1943, resulting in contracture of the axilla in adduction. Grafting was done on December 4, 1943, using a graft of .018 of an inch in thickness. Due to the extremely high recess in the apex of the axilla, a stitch was placed to prevent the graft from inverting itself. Vaseline gauze, plain gauze and adhesive were used to keep the gauze in place. The result was very good.

Case II. A female, age fourteen years, was burned at the age of six years. The result was axillary contracture and scar. The scar was removed and grafting done on December 11, 1943, using a graft .016 of an inch in thickness. The result was excellent.

Case III. A male, age forty-eight years, had a cicatricial ectropion secondary to removal of carcinoma of the left cheek. The scar was excised and a tarsorrhaphy according to the Wheeler technic was done. A full thickness graft from the medial side of the left arm was taken, freed of all fat and applied to the defect. The graft showed an excellent take when the first dressing was done five days later. The second dressing was done later and a split in the graft showed and it appeared dry. There was some purulent material about the graft and it had retracted some from the margins. The patient still has a fair result. I was advised by the resident surgeon and the dressing nurse that the patient was very unco-operative and removed the dressing because it itched.

Case iv. A female, age thirty, had a third degree burn on the posterior two-thirds of the leg and popliteal space on October 1, 1943, resulting in a granulating surface that was not healing. This patient was grafted on December 18, 1943. A graft .016 of an inch thick was used and the result was excellent.

Case v. A female, age fifty-two, suffered a third degree burn of scalp, face and hands on November 3, 1943. This patient's burned area was grafted to prevent, if possible, any facial deformity. The area was granulating and was slightly infected. A .020 of an inch graft was made and the usual dressings applied. There was a complete take of all the grafts. The graft which was 10 cm. by 15 cm. was split into three parts.

Case vi. A male, age thirty-eight, had a keloid of the neck about 1 cm. thick, extending from ear to ear and from the border of the mandible to the clavicle. This keloid had been subjected to a long series of x-ray treatments prior to surgery. The keloid was resected and hemostatis obtained. The raw area produced was covered with a graft .022 of an inch in thickness. Because of the angle of attachment at the border of the mandible, I believed it advisable to tack the margins above to prevent the graft from sliding down. About four sutures were placed. This graft was fitted well. A vaseline dressing was applied. The first redressing was done about the fifth day. The graft looked a deep purple, except in one area at which there was a blister. This was opened and a seropurulent material was expressed. A white appearing necrotic tissue about 1 cm. in width and about 2 cm. in length was excised. One very small area near one corner also had to be removed. The graft showed about a 90 per cent take. It was noted as the margins of the necrotic tissue were separated that the remaining tissue was highly vascular. A 5 per cent sulfathiazole ointment was then applied. The infected areas cleared up. There were several areas of granulation that were touched up with silver nitrate and a good result was obtained.

Case vii. A female, age twelve, had a third degree burn of the entire right side of the body including the entire upper and lower extremities. This was the neglected case described previously. All areas were granulating and the patient's condition was poor. The child was apprehensive and whining and had a septic temperature. Sulfonamides and eight transfusions were given.

In this case the heterogenous graft with the patient's plasma and cell extract was used. The result was excellent. A graft .014 of an inch in thickness was used. The area was redressed on the third day and showed a much lighter purple color than the grafts that were used on clean fields. After two weeks, there was marked improvement.

Case viii. Same child as above in Case vii except that at this time, the father's skin and his plasma and cell extract were used. The granulating area was infected, but apparently it made no difference insofar as the graft was concerned. This case will be watched to determine the length of time and ultimate fate of the heterogenous graft. Thus far the results have been satisfactory.

Case ix. Same patient as in Case vii except this reports the third operation. An outside donor with a stock plasma and cell extract were used. The results were excellent.

In the few cases here reported, I have noted that the grafts do better on granulating surfaces. I have also noted that the color five days after grafting on granulation tissue, seems reddish, while the grafts on new bases appear more purplish. The grafts on the cheek and the one on the pectoral region became corrugated and dry. I cannot account for this observation at this time.

There is some slight difference in the technic of the last few cases. Dr. Sano removes the graft and places it upon a piece of gauze and then paints on the cell extract. I paint the cell extract on the graft while it is still on the drum, when the Padgett machines are used. In freehand grafts and in full thickness grafts, when they are dissected, it is of course obvious that the graft must be placed upon some type of material. I believe that painting the cell extract on the graft while still on the drum might be advantageous because the fluid has a better opportunity to fill all the interstices and after it is removed from the drum, the graft shrinks, but the entire surface of the graft will have been covered, with the result that it has a better chance of agglutinating to the entire surface.

In two instances I used impregnated vaseline gauze covered with a layer of 5 per cent sulfathiazole ointment, because the area was definitely infected. The results were excellent. I am not attributing the result to the sulfathiazole ointment, but it may play an important rôle in infected cases. It certainly does no harm to use it. In the remainder of the cases, I used impregnated gauze only with one exception—the neck graft which showed an infected blister. In this case I switched to 5 per cent sulfathiazole ointment. The results were good.

In redressing the above patients, I used a warm saline pack or compress for a few minutes before re-applying the dressing. In some cases I used a bulb syringe and irrigated with the warm saline solution, and I cannot see any difference.

Complete hemostasis must be accomplished in all cases before the grafts are applied.

I believe that Dr. Sano has made an important contribution to the subject of skin grafting, and I wish to express my deep appreciation for the wonderful work she has done.

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THE IMPORTANCE OF LATENT HEPATIC DISEASE

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THIS study was made from the point of view of the surgeon, who, during the course of operation upon the liver and/or the biliary tract, encounters changes in the gross appearance of the liver which indicate to him that previous disturbance had occurred therein, and which either may or may not have pathogenetic relation to the present lesion. In either case it becomes necessary for the surgeon to form a judgment regarding any such possible relation, and to evaluate the resultant damage to the liver with the object of determining the immediate and late prognosis both from the standpoint of the previously existing lesion, from the standpoint of the effect of the latter upon the present lesion, and, as a consequence, the resultant effect of both.

This study will, therefore, contain: First, a resume of the available knowledge of the biological and pathogenetic development of the metabolic and/or toxic cellular degenerative and necrotic changes in the liver parenchyma including both experimental and clinical data; second, the relationship of inflammatory lesions in the gallbladder and biliary tract to these liver changes either as its consequence or as a pure coincidental phenomenon; third, the potential effect of the liver changes in influencing the prognosis after operation upon the gallbladder and/or the biliary tract; fourth, the precautionary lessons to be learned in safeguarding such operations in the presence of pre-existing hepatic disease.

The terminology of the actual anatomical changes present in liver disease as reported in the literature, reveals a variety of terms apparently intended in part to cover the same fundamental changes. They may be roughly classified as fatty infiltrative changes, various forms of degenerative change, ranging from mild hyaline changes to actual necrosis, acute, subacute and/or chronic hepatitis, acute and/or subacute forms of yellow atrophy, and the various cirrhoses. Frequently the same liver reveals various degrees of all or many of these changes in different areas. Occasionally, the forms of yellow atrophy are confounded clinically with the hyperacute variety of acute cholangitis. An attempt will be made to clarify this apparent confusing terminology as the subject is being developed in this communication.

Practically all of these destructive changes in the liver parenchyma are ultimately followed by connective tissue changes, and the resulting fibrosis is customarily known as "cirrhosis." The term was originally used for a clinical group associated with alcohol as a causative agent and with the name of Laennec. When applied to other forms of hepatic fibrosis the term is, therefore, misleading. It seems better to use the expression "chronic interstitial hepatitis" as a generic term for all forms of hepatic fibrosis and to limit the term "cirrhosis" as previously indicated. Similarly, the term "biliary cirrhosis" should be employed for a special group of cases. The use of some person's name as a distinguishing mark of a certain group, e.g., Hanot's Budd's or Laennec's cirrhosis, is unfortunate as it gives no inclination by itself of the essential pathological lesion and/or disturbance.

METABOLIC HEPATIC CELLULAR CHANGES AND REGENERATIONS AND THEIR RELATION TO CONNECTIVE TISSUE PROLIFERATION

Normal and Pathological Fat Metabolism. Ordinarily fat is not accumulated in the liver. Fatty infiltration of the liver occurs in those conditions in which, because of lack of intake or absorption of food, fat is mobilized from the existing fat depots, and in which the accumulated fat cannot be broken down for use. Coope and Mottram noted some increase of fat in the liver during pregnancy and lactation in rabbits. Neutral fat may be found in small amounts after a meal containing a great deal of fat, but it is probable that in most other instances in which neutral fat may be demonstrated, grossly or microscopically, the condition is due to some interference with normal carbohydrate-fat catabolism and is pathological. The conditions in which fatty infiltration may occur or be produced experimentally include: (1) A diet in which carbohydrates are decreased to a minimum or are absent (meat diet in an herbivorous animal); (2) the wasting diseases—tuberculosis and malignant tumors particularly, in which there may be a demonstrable lipodemia; (3) disease of the intestinal tract accompanied by diarrhea; (4) poisons as ether, chloroform, carbon tetrachloride and alcohol definitely interfere with carbohydrate metabolism, and so with the proper oxidation of fat;[37,62,93,95] (5) severe inanition. To some extent it is present in subjects who have been dying slowly and who are either not eating enough or not assimilating their food. In the first instance it results from external starvation, in the second, from what may be called internal or tissue starvation. This was produced in experimental animals by Dible and Libman.[24] (6) The moderate infiltration of the liver found in vitamin B_1 deficiency is probably due also to the influence this substance has on the proper oxidation of carbohydrates.[20,36,92,93,102] Lipschitz and his co-workers found that vitamin B_1 deficiency was followed by serious impairment of the pyruvic acid metabolism in the liver and by deranged carbohydrate metabolism in the entire organism.

The accumulation of fat in the liver does not seem to be a static phenomenon. Fat passes into and out of the liver freely and with astonishing rapidity. When a sufficiently large amount of fat remains in the liver, serious metabolic and mechanical effects follow including mechanical pressure and local tissue anoxemia.

HEPATIC CELLULAR DEGENERATION AND NECROSES, PRODUCED BY VARIOUS CHEMICAL AGENTS, AND THEIR RELATIONS TO PROLIFERATIVE, HYPERTROPHIC CONNECTIVE TISSUE CHANGE

A review of the experimental work shows that numerous agents, most diverse in character, are capable of causing these changes. They include various chemicals, both organic and inorganic, certain drugs and tar-like substances, foreign proteins and products of protein decomposition. More particularly, degeneration and necroses of various forms, character and extent have been produced: (1) *With phosphorus:*[23,73,131] Very profound phosphorous effects have been associated with hypertrophic intralobular connective tissue changes. (2) By arsenic:[79,83,89,100,131] These are clinical observations, of course, because of the effects of the salvarsan and similar arsenicals. *With lead:*[39,61,131] In 1900 and 1901 *cirrhosis occurred* as a complication in the outbreak of arsenical poisoning which occurred in the English Midlands. It was thought to be due to a contaminated beer supply. (3) *By manganese:*[3,27,46,53,78,97,131] (4) *With copper:*[4,29-43,44,48,74,75,91,94,109,123] Copper which may contaminate spirits and is used to color peas has been incriminated as responsible for hemochromatosis and its accompanying cirrhosis.[131] (5) *With silica:* Experimentally, chronic poisoning by colloidal silica produces hepatic cirrhosis[39] but this effect has not been established in man. (6) *With various organic compounds:* A wide variety of organic chemicals and substances of protein composition have been used experimentally with resulting damage to the liver. Immune sera and anaphylactic reactions have resulted clinically in necroses of liver cells of varying degrees of intensity, in chronic inflammatory changes, and in varying degrees of fibrosis up to marked cirrhosis with obliteration of lobular pattern.

EFFECT OF ALCOHOL WITH OR WITHOUT OTHER ASSOCIATED AGENTS

Effect of Alcohol Alone. A summary of the large amount of the experimental work in which alcohol was used to produce cirrhossis can be found in numerous papers.[10,38,54,58,66,88,103,107,108,121,131] Ethyl and amyl alcohol were the forms of alcohol most often used, and the experiments have most commonly been done on rabbits. Unfortunately, these experiments are difficult to evaluate because rabbits frequently develop a form of chronic hepatitis with cirrhotic changes spontaneously.[27,113,121,131] No cirrhosis has been reported in experiments with alcohol in animals other than rabbits. Several observers stated that the livers of dogs, rats, guinea pigs, etc., were much more resistant, and based their conclusions on the rabbit experiments claiming that rabbits were especially suitable for these experiments. Although the majority of these experiments, probably, have no etiologic significance in the development of human cirrhosis, the investigations have contributed greatly to an understanding of the biological mechanism whereby cirrhosis develops.

The belief that cirrhosis is caused by alcohol has not received experimental support. Alcohol alone produces fatty infiltration in the liver[63,106] and it increases the rapidity and degree of infiltration of a high fat diet[13] by interfering with tissue oxidation.[7,50,81] Van Wulfften Palthe showed that death from a lethal dose of alcohol can be prevented by oxygen inhalation. A relative and sometimes absolute starvation is constantly associated with severe chronic alcoholism and the development of fatty infiltration of the liver most often depends on a combination of these two;[102] and it appears as indicated previously, that the dietary deficiency is in itself detrimental to the normal liver physiology.

A significant experiment with negative results was done by Friedenwald[33] under the auspices of the Committee of Fifty in which whiskey or absolute alcohol were used. The fatty changes noted in the liver, heart and kidneys of a large majority of the animals were only temporary in nature and in those animals in whom treatment with alcohol had been discontinued, they were entirely absent.

Effect of Combinations of Alcohol with Other Agents. It is significant that combinations of agents have been found more effective than either of the same agents alone, and that in these combinations alcohol is the most frequently found component. It seems reasonable to assume that alcohol acts in these combinations as a contributing, predisposing or adjuvant factor. In this respect alcohol has been found to accentuate the injurious effects of phosphorous, manganese, hydrazine, chloroform, carbon tetrachloride, cholesterol, bacterial infections, and the effects of diet in experiments with phosphorous, chloroform and carbon tetrachloride. It is probable that alcohol may similarly accentuate the effects of other injurious agents upon the human liver and so be in reality only an important contributory factor in the development of human cirrhosis.

Effect of Hydrazine, Tars, Amyl Alcohol, etc. The production of cirrhosis by means of amyl alcohol, hydrazine, tars and similar organic chemicals has duplicated rather accurately the picture of the Laennec lesion (gross and microscopical histological changes, splenic changes, ascites, etc.). This seems to have an important clinical bearing: (1) Because it has been suggested that intemperance has been productive of hepatic cirrhosis by virtue of the content of liquors other than ethyl alcohol, e.g., amyl alcohol; (2) because hydrazine, tar and/or tar-like bodies of the benzene series are formed by the charring of the casks used in the aging of liquors and it is possible that these substances so formed may be the actual agents for the development of clinical cirrhosis and not the alcohol; and (3) copper and arsenic, previously referred to are commonly found as contaminants in beer and other liquors and are similarly implicated.

Effect of Chronic Alcoholism. Although alcoholism is a very frequent antecedent of portal cirrhosis, its action as suggested above, is probably indirect, namely, in part by reducing the resistance of the liver cells and in part by favoring intestinal infection and catarrh and so the production of poisons which are then able to act on the liver cells. Thus the combined actions of two factors may be successful, though isolated they fail, in inducing cirrhosis.

The cirrhosis of the liver observed in chronic alcoholism is probably the most important of various forms. New experimental evidence developed by Gyorgy and Goldblatt[40] of Western Reserve University suggests the possibility that nutritional factors are involved in the development of this form of damage to the liver. Experimental work with animals indicates that the essential cause of alcoholic cirrhosis in man may be a low protein intake associated with a deficiency of the vitamin B complex.

EFFECT OF CONDIMENTS, SPICES, ETC., AND OF INTESTINAL DECOMPOSITION PRODUCTS

Chronic interstitial hepatitis may be due to spices and other condiments taken with the diet, such as curries, pepper, ginger and other stimulating foods; these may lead to the formation of toxins or of fatty acids, such as butyric, lactic, acetic, and valerianic,[12] which, like paracresol phenol and indican,[84] have been shown experimentally to induce cirrhosis. To this dyspeptic cirrhosis, which probably occurs mainly in persons with defective resistance of the liver, Hanot, gave the name Budd's cirrhosis. It is sometimes hard to draw a line between poisons produced in the intestine as the result of digestion and/or decomposition and the influence of the ingested substances themselves. Vinegar and mussels[132] have also been regarded as capable of producing cirrhotic changes.

HEPATIC CELLULAR DEGENERATIONS, ETC., OCCURRING IN CLINICAL CONDITIONS

In Toxemia of Pregnancy. Pathologically, scattered areas of hepatic lobular necrosis appear with some frequency in a certain proportion of cases of pregnancy complicated by "toxemia." It is to be noted that in pregnant patients necrosis of the hepatic cells begins in the periphery of the lobule and increases progressively toward the center, whereas in non-pregnant patients presenting the hepatorenal syndrome the cellular necrosis begins in the center of the lobule and spreads toward its periphery.

Some importance must be added to this because of the infrequency with which cholelithiasis seems to originate in the metabolic changes with the physiologically abnormal fat and cholesterol metabolism during pregnancy.

Chloroform Poisoning. Delayed chloroform poisoning* appears to be much more common in obstetrical than in other types of patients. According to Sheehan it occurs in the following anatomical differentiation: (1) In the isolated-cell lesion group, the result appears to be due to an overdose of chloroform in a healthy subject. Microscopically there is a lesion with a peculiar affinity for certain individual cells in the liver columns, leaving quite untouched other cells between the damaged ones. The affected cells are about twice the normal diameter, ballooned to a spherical shape and have clear, non-fatty cytoplasm with pyknotic nuclei. (2) The mid-zonal necrosis group is the most common type of lesion in obstetrics. Microscopically, the essential lesion is a variable but quite universal mid-zonal necrosis. There is no evidence that sepsis plays any part in the production of the liver lesions. (3) *The central necrosis group:* This form is usually associated with hyperemesis, gravidarum, and interruption of pregnancy in a patient insufficiently nourished, and is usually fatal. Microscopically, the central zone and the inner part of the midzone of the liver are completely necrosed, the outer half of the midzone shows a definite fatty change but appears visable, and the periportal zone is intact.

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* Delayed chloroform poisoning is almost entirely confined to patients who have a gross metabolic disturbance before the administration of the anesthetic. The factor of a starvation acidosis appears to be common to all cases. Sheehan[111] emphasizes that the patient who has been left in labor for a few days without adequate treatment is extremely susceptible to what may be regarded rather as a poisoning by delayed chloroform anesthesia than as a delayed poisoning by chloroform. Repetition of chloroform anesthesia after an interval of a day or two may lead to damage if the patient has been allowed to develop acidosis after the first anesthesia.

In Association with Estrogen Therapy. Very large doses of the natural estrogens-estrone, estradiol benzoate and the synthetic estrogen diethyl-stilbestrol produce changes in the liver, consisting of fatty and hydropic degeneration, confined chiefly to the middle zones of the liver lobules with slight shrinkage of the hepatic cells centrally. Moderate amounts of intracellular and extracellular hemosiderin in fine granules are present in the central zones together with a few polymorphonuclear leukocytes.

MacBride, Castrodale, Helwig and Bierbaum[69] found that in general, alterations in the parenchymal cells were not widespread or prominent. Since these changes occurred before the appearance of any hemorrhagic state, they were presumably the result of direct action on the liver. Extramedullary myelopoiesis occurred within the livers of animals receiving these estrogens. These workers found that the amount of glycogen present within the livers as determined by Best's carmine stain showed considerable variation but was usually scanty. In no instance could glycogen be demonstrated in the large clear vacuoles. No correlation could be established between the amount of glycogen present and the degree of fatty and hydropic degeneration.

It seems unlikely that the usual therapeutic doses of diethylstilbestrol or of the natural estrogens will produce hepatic damage clinically, and MacBride, Castrodale, Helwig and Bierbaum[69] have not been able to detect by clinical observation or tests of hepatic function any evidence of damage to the liver among a large number of patients treated with diethylstilbestrol.

Association with Thyrotoxicosis. There are many observations on the simultaneous occurrence of exophthalmic goiter and chronic interstitial hepatitis.[5,8,42,71,96,104,125] Rössle[104] showed that marked thyrotoxicosis produces extensive hepatic necrosis. Moon's survey showed that the American states having the highest death rate from thyroid disease were correspondingly high in deaths from chronic interstitial hepatitis and vice versa. Similarly in Europe, the highest occurrence of cirrhosis on record is in Switzerland, where goiter also is most prevalent. It is known that livers with low glycogen content have an increased susceptibility to injury; and it is thought that hyperthyroidism may contribute to the development of chronic interstitial hepatitis by producing hepatic glycopenia.

Toxic Effect of Burns. There is a marked hepatic effect after severe burns. There is widespread, midzonal necrosis with hyalinization and fragmentation of the individual cells, the sinusoids are distorted but the central veins are well preserved, the liver cords are somewhat jumbled but the lobular markings are still distinguishable. According to Best,[9] it is not a liquefactive necrosis nor is it accompanied by more than slight polymorphonuclear reaction. It involves the cells somewhat unevenly, sparing some altogether, affecting others only in part. There is an associated fatty change of moderate degree which gives the cytoplasm a rather moth-eaten appearance. Councilman bodies are much in evidence. Nuclear bodies of the type described as class A by Cowdry[133] are a prominent feature.

Effect of Tannic Acid Used in the Treatment of Burns. The relationship of tannic acid used in the treatment of the burned area to this constant pathological change in four clinical cases was suspected and investigated experimentally by Wells, Humphrey and Coll.[126] Seventy-seven rats maintained either on a standard or house diet were given subcutaneously one or more injections of a 5 or 10 per cent solution of tannic acid. At the postmortem examination of these animals, depending on the amount and the frequency of the injections of tannic acid solution, the microscopic findings included central necrosis, and all stages of hepatic cell degeneration, hemorrhage, and leukocytic infiltration. Wells, Humphrey and Coll[126] assume, therefore, that the use of tannic acid resulted in the liver damage.

OBSTRUCTIONS IN THE BILE RADICALS AND DUCTS AND ITS RELATION TO INTERSTITIAL CONNECTIVE TISSUE PROLIFERATION—OBSTRUCTIVE BILIARY CIRRHOSIS—LEGATION OF THE CHOLEDOCHUS—BILIARY STASIS

Obstructive biliary cirrhosis, consisting in fibrosis spreading out from, and due to obstruction of the bile ducts, has caused much debate. In clinical medicine obstruction of the common bile duct, for example by carcinoma of the head of the pancreas, is very rarely associated with fibrosis of the liver, although it causes dilatation of the intrahepatic bile ducts, icteric necrosis and atophy of the liver cells. In gallstone obstruction of the common duct the results are not so constant: in some instances cholangitis and pericholangitic fibrosis is present; in others the liver resembles that in aseptic obstruction of the ducts by a growth. The hepatic fibrosis associated with congenital obliteration of the ducts has been regarded by John Thomson, Beneke, Ford and Lavenson[119] as due to the obstruction of the ducts, but the obstruction of the ducts may be secondary to a descending inflammation from the small intrahepatic ducts which is responsible for or is associated with a preexisting fibrosis. In a study of 184 cases of interstitial hepatitis ascribed to obstruction Mangelsdorf[77] found that there was no constant form of fibrosis.

Experimental ligation of the choledochus has been performed by various authors who have described a typical biliary cirrhosis as the result of the intervention. The liver was slightly increased in size and histological examination revealed extensive new formation of connective tissue, the picture being identical with that of the fibrosis seen with biliary stasis. The greater severity of the lesions found in these animals was undoubtedly due to their longer survival and, as any effective influence of infection could be excluded, there remained only biliary stasis as the direct cause of the hepatic changes.

Rous and Larimore[105] found experimentally that septic obstruction involving the larger bile ducts causes a stellate fibrosis around them; obstruction of the small bile ducts in the portal spaces is followed by a pure unilobular fibrosis; and obstruction of the intralobular bile canaliculi leads to a diffuse intralobular fibrosis. The diversity of the hepatic changes depends on differences in the duct levels at which the injurious factor is active. McMaster and Rous[82] have also shown that obstruction of the common duct, when the gallbladder is able to perform its concentrating action, leads to distention of the intrahepatic ducts with thick tarry bile; whereas when the gallbladder is functionless the fluid distending the ducts is "white bile," and the condition may be described as a "manifest hydrohepatosis."

MISCELLANEOUS LIVER CONDITIONS ASSOCIATED CLINICALLY WITH CHRONIC PRODUCTIVE CONNECTIVE TISSUE CHANGE

Various forms of chronic productive hepatitis are found with a miscellaneous group of conditions including: chronic cardiac engorgements; thrombosis of the hepatic veins; surrounding foreign bodies, or areas of hemorrhage; around parasitic cyst formation (echinococcus, etc.); around tumor formation, abscesses, or areas of typhoid degeneration; in hemochromatosis, anthrocotic conditions and in malaria.

An incomplete or partial obstruction of the hepatic veins may cause complete fibrosis of the lobe or lobule of the liver involved, with symptoms similar to those found in complete obstruction but less severe.

Cases of disease of the right ligament of the liver in the literature are very rarely associated with vascular changes similar to those occurring in cirrhosis of the liver. Nevertheless, these forms of chronic productive connective tissue change should not be confused with true cirrhotic conditions as the term is generally understood.

COMPARATIVE PATHOLOGIC STUDIES

Chronic Interstitial Hepatitis in Wild Animals. The long debate as to the primary factor in cirrhosis,* primary parenchymatous change with replacement fibrosis, or primary connective tissue aggression, is interestingly met by Herbert Fox,[31] in the corresponding study made in wild animals confined in a zoological garden. The following classification was used in the animals: (1) Scar tissue, therefore, an end or result following toxic degeneration in the liver (so-called toxic cirrhosis); (2) pigment cirrhosis; (3) portal cirrhosis with enlargement or atrophy of the alcoholic or Laennec type; (4) biliary or Hanot cirrhosis with enlargement or atrophy or obstruction, with manifest inflammatory lesions within and around the biliary canaliculi; (5) specific cirrhoses, tuberculous, syphilitic, and Pictou cattle cirrhosis of Adami (?); (6) perihepatitis and perilobular fibrosis, and (7) passive congestion cirrhosis.

The animals were fully developed and therefore classed as adult. There were seven males and nine females; of one the sex is not recorded. The time in the garden merely indicates how long the animals have been fairly under uniform conditions of life. There are naturally no clinical data available during the life of the animals and the conditions were not diagnosed or even suspected before the postmortem examination.

In the accompanying Table Fox[31] tabulated the pertinent data of seventeen instances of cirrhotic liver disease which he has encountered in such animals. (Table I.)

The portal cirrhoses are represented by four cases, of which all showed notable hepatic pigmentation but no jaundice; one had intestinal varices, but no hemorrhages are recorded. In the four portal cirrhoses, three chronic and one subacute case of splenitis were noted. All cases of portal cirrhosis had chronic interstitial nephritis, while six of the biliary type had chronic changes and one had acute changes in the kidneys. In none of the cases was there pancreatic disease. On the other hand, ten of the seventeen cases showed changes in the spleen. In the biliary type, five cases of splenic inflammation existed, four being chronic and one acute hemorrhagic. The odd cases were diagnosed by Fox[31] as perihepatitis and passive congestion fibrosis, a typical Laennec's or Pictou cirrhosis of Adami, and perilobular fibrosis.

It appears from this record that in the pathology of cirrhosis of the liver in wild animals confined in a zoological garden the common systemic causes usually present in humans—alcohol, syphilis, lead, etc., can be excluded from the pathogenesis of this disease. Fox emphasized the small percentage of these cases, which showed, clinically, disturbance of the gastrointestinal tract. Nevertheless, he comments upon the frequency with which infections in these animals emanate from the intestinal tract. Ulcerating lesions are more common in the intestines of animals than they are in man. This may permit food or protein poisoning which if repeated suffi-

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* The term "cirrhosis" and the other terminology in this section are those employed by Herbert Fox in his paper.

TABLE I

No.	Common Name	Type of Cirrhosis	Age	Sex	Time in Garden	Gastrointestinal Lesions	Spleen	Kidney	Varices	Liver			
										Size	Fatty	Pigmentation	
421	Bubaline antelope	Biliary	Adult	Fem.	11 yr.	Chronic	Moderate chronic splenitis	Chronic diffuse nephritis	....	Small			
754	Common racoon	Portal	Young	Fem.	Few days	Chronic	Moderate fibrosis	Chronic diffuse nephritis	....	Normal	+	+	
969	Japanese Macaque (Tuberculous)	Biliary	Adult	Male	Few months	....	....	Chronic interstitial nephritis	....	Normal	....	.....	No evidence of T.B. in liver
1112	Levaillant's Amazon	Biliary	Adult	?	?	Chronic Tuberculous Enteritis.	....	?	....	Small	....	+	
1153	Gray Wolf	Perihepatitis and Passive Congestion	Adult	Male	Six yr.	Chronic	Moderate fibrosis and congestion	Subacute diffuse nephritis	Intestines	Large	+	Slight	Myocarditis ascites
1416	Fallow deer (tuberculous)	Biliary	Adult	Male	One yr.	....	....	....	....	Large	....		
1461	Indian elephant	Portal	Adult	Male	Twenty yr.	....	Fibrosis and pigmentation	Chronic parenchymatous nephritis	?	?	....	Normal	
1539	Red brocket	Biliary	Adult	Fem.	Four yr.	....	Hemorrhage	Chronic parenchymatous nephritis	....	Normal			
1660	Virginia deer	Biliary	Adult	Male	Two yr.	....	Chronic splenitis	Chronic parenchymatous nephritis	....	Small			
1857	Capybara	A typical Laenneor Pictou	Adult	Fem.	Nine mo.	....	....	....	....	Small	Slight		
2516	Clouded leopard	Portal	Adult	Fem.	Eleven yr.	....	Chronic splenitis	Chronic interstitial nephritis	....	Small	....	+	
2530	Black tailed Wallaby	Biliary	Adult	Fem.	Two and half yr.	....	Chronic splenitis	Acute parenchymatous nephritis	....	Large	....	+	Choledochitis
2590	Texas skunk	Portal	Adult	Fem.	Four yr.	Acute gastritis	Subacute splenitis	Chronic diffuse nephritis	Intestines	Small	+	+	
2850	Indian paradoxure	Biliary	Adult	Male	Twelve yr.	....	Chronic splenitis	Chronic interstitial nephritis	....	Large	....	+	
2950	Mexican guan	Biliary	Adult	Fem.	Four yr.	....	....	....	....	Normal	+	+	
3119	Common racoon	Perilobular	Adult	Fem.	Seven yr.	....	....	....	....	Normal	....	+	
3199	Aoudad	Biliary	Adult	Fem.	Ten yr.	....	Congestion	Chronic parenchymatous nephritis	....	Small	....	+	

ciently often, may initiate changes in the liver parenchyma. The view held in many quarters that the forms of biliary cirrhosis all find their origin in infection seems to be corroborated by the proportion of ten cases in the seventeen studied, in which a frank progressive, inflammatory condition was found. The very frank infectious forms in these animals were progressive with active interstitial cell and fibrous tissue but with little tendency to intralobular penetration. When the latter was found it was nearly always present near the capsule or hilus of the liver. Taking it all in all, this comparative study will tend to emphasize the infectious origin as being commonly responsible for hepatic cirrhosis.

Chronic Interstitial Hepatitis in Domestic Animals. Enzootic hepatic cirrhosis has been described by Kalkus, Trippeer and Fuller[55] in horses ("walking disease"), occasionally in cattle, and not uncommonly in hogs ("hard liver disease" or "Walla Walla* hard liver disease"), in the wheat-producing regions of the Pacific Northwest and in certain sections of Idaho and Oregon where the condition is more generally known as "protein poisoning" or "winter wheat poisoning" because its occurrence has been associated with the feeding of certain diets, especially those high in winter wheat.

The most striking pathological change found was an extensive destruction of the hepatic tissues and replacement with fibrous tissues. In very acute cases the liver was swollen; in more chronic cases, it was shrunken and extremely hard. In one chronic case, adhesions had formed between the lobes of the liver, and the wall of the gallbladder was extremely thick and fibrous. In the absence of an unusually severe anemia, icterus is pronounced. In the early cases in pigs there was a beginning necrosis of the cells.

Swine which had been allowed to continue on experimental feeding with the seeds of tarweed—Amsinckia Intermedia—revealed at death an extreme hypertrophic cirrhosis of the liver with hyperplastic and toxic changes in the remaining parenchyma. The lobular architecture was obliterated and the connective tissue exceeded the parenchyma in amount. The parenchymal cells often were greatly enlarged and some contained several nuclei, as if from confluence of several cells. In some of the sections examined, not more than four or five normal hepatic cells appeared in a microscopic field. The spleen also was involved and in many of the acute cases was enlarged, while in the chronic cases it appeared to be somewhat fibrotic. The kidneys were hemorrhagic in some horses and the bladder filled with blood-stained urine.

Comparative Human Experience. This animal experience should be compared with the following report of one in humans: In 1918, certain cases of sickness of obscure causation occurred in the George district of Cape Province. Whole families had suffered from time to time from a complaint the chief symptoms of which were abdominal pain and vomiting, with ascites. Investigations showed that the plants known as Senecio ilicifolius and Senecio burchelli grow as weeds in the wheat fields at George, and that when the wheat is threshed the seeds and portions of these plants frequently remain behind and are solid with the wheat. Experimental animals fed on portions or seeds of these plants developed symptoms and mainfested post-mortem appearances similar to those noted in man.[134]

Leonard Rogers[135] considers that chronic amebic hepatitis is a frequent cause of chronic interstitial hepatitis in India. Poisons manufactured in connection with the presence of uncinaria duodenalis and bilharzia hemotobia in the intestine have been thought to cause these liver changes among Mohammedans in Egypt and in South African natives.[136] The occurrence of pigmented cirrhosis in connection with the rare occurrence of foreign bodies such as particles of carbone or stone in fibrotic livers is referred to elsewhere. An endemic form of unicellular interstitial hepatitis with hepatic enlargement, jaundice, and continued fever, but without splenomegaly was described in 1897 by Carmono y Valle[130] in Mexico. Ascites is often present and the disease runs a rapid course in six to eight months.

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* So-called because many cases have been observed in Walla Walla County, Wash.

Geographic Distribution of Cirrhoses. Chronic interstitial productive connective tissue change in the liver is found in all parts of the world. Cirrhosis of the liver may be found as frequently in some countries where alcohol is used but little as in others where its use is habitual, but a common predisposing factor is present in each instance, namely, failure of alimentary absorption. Cirrhosis is mainly seen in chronic tipplers, not in spasmodic drinkers. During the war restriction in England and Wales of alcoholic stimulants appeared to be correlated with the fall in the death rate from cirrhosis from 4,148 in 1914 to 1,730 in 1918,[115] and in Chicago the deaths from cirrhosis appeared to fall after the introduction of prohibition.[86] But that alcoholism is not an exclusive antecedent of cirrhosis is proved by the incidence of the disease in life-long abstainers and Mohammedans.

Yenikomshian[129] found that cirrhosis is particularly prevalent in the rural population of Tyre and Sidon where alcoholic drink is taboo. A history of amoebiasis (dysentery) or malaria was regularly found in such cases and he believed that a combination of the two is the most important cause for cirrhosis in that population. Infestation by intestinal parasites is prevalent among these peoples, and the average age of those who acquire cirrhosis of the liver is much lower than it is in this country. According to a report by Rolleston and McNee,[101] cirrhosis of the liver is much more frequent among the natives of India than it is among white people. Records of 535 autopsies done on natives of Vizagapatam revealed that 9.3 per cent had cirrhosis of the liver. Twenty-five patients were found to have portal cirrhosis. Tirumurti and his co-worker emphasized the fact that the people of this locale do not drink alcohol. It was affirmed by Bloomfield[11] that cirrhosis of the liver may progress to a far advanced stage before it causes symptoms or produces changes which induce the patient to seek medical care and by the same token may cause the clinician to fail to make a correct diagnosis. In most instances a review of the history gives no indication as to the time of onset of the disease. Also the prognosis is uncertain because of a lack of knowledge concerning the complex alterations of metabolism that result from disease of the liver.

An infantile form of endemic biliary cirrhosis, occurring among the Hindus in India, during the first two years of life, at first as a unicellular and subsequently as a unilobular cirrhosis, has been thought to be due to toxic bodies in the food taken by the nursing mothers who restrict themselves to a dry diet and take a decoction of pepper.[137]

RELATION OF ACUTE AND CHRONIC INFECTION OF THE LIVER (HEPATITIS) TO CHRONIC INTERSTITIAL CONNECTIVE TISSUE CHANGE

Acute and Chronic Hepatitis. The discussion of the somewhat indefinitely used term "hepatitis" is beset by many difficulties. The discussion must include hepatitis as a single entity and must, nevertheless, include its very complex and diversified etiology, and its differentiation from various forms of cellular change and degeneration. It is also very difficult to establish the recognizable point at which any of these anatomical changes reach the plane of clinical observation. The problem of cellular change, varying from purely functional abnormality to various grades of cellular degeneration and destruction, must be considered as opposed to actual inflammatory change. And in the field of cellular functional or morphological change, one must note the lack of evidences of any hyperfunctional or hypertrophic change and the universal evidence of diminution in function and destructive change in cellular morphology.

Hematogenous and Metastatic Infection. In spite of the fact that the liver is known to have a high bactericidal power,[35] infections in animals are known to be followed by chronic inflammatory changes which resemble Laennec's cirrhosis closely.[76,90] In human pathology, in all forms of general infection (typhoid, pneumonia, scarlet fever, small pox, secondary syphilis, malaria and infections by staphylococci, streptococci, etc.) there is a period when the micro-organisms are found in the blood stream. During the period when an immunity is being established, they disappear from the blood stream and are found deposited in the liver and other organs. In postmortem examinations, aside from various parenchymatous and degenerative changes, the liver shows frequently a round-called infiltration in the interstitial tissue and focal necroses. In other words, some degree of hepatitis is almost always present, often giving little or no clinical evidence of its presence. Due to some special circumstance, predisposition or sensitization, the parenchyma cells may be enough affected to interfere with their normal function of excreting bile. Jaundice, occurring under such condition, is an indication of hepatitis even though no other distinctive sign of any such lesion is demonstrable. Such forms are frequently recoverable from without causing further changes in the liver unless some additional toxic and/or other influence is brought to bear.

Metastatic inflammatory lesions are commonly found in the liver originating in intra-abdominal infections notably in the appendix or in the hemorrhoidal area. Commonly these resemble the previously described forms of hepatitis, recognizable, clinically by temperature and mild jaundice. Less commonly hepatic suppuration occurs.

Clinical Course of Acute Hepatitis. The initial stage of hepatitis may be clinically acute and promptly fatal. This group includes not only cases of so-called acute yellow atropy but also instances of a less violently destructive process, which, latterly, have been classified under the generic term of "toxic cirrhoses." An equally acute onset may be followed by complete clinical recovery and probably by healing of the lesion, although it is hard to prove that latent anatomical changes are not present. The possibility of such latent changes, which may gradually progress over many years until clinical hepatic insufficiency supervenes, is shown by those rare instances of later cirrhosis in which a story of acute hepatitis years ago can be elicited (Vide infra). It is sometimes possible to observe clinically such latent periods over long periods of time. The latent periods may be punctured by clinical exacerbations which again subside into latency, and thus such a cycle may be repeated a number of times before the patient dies. Bloomfield[11] points out the analogy between these long drawn out liver cases to the course of glomerular nephritis.[2]

ACUTE YELLOW ATROPHY OF THE LIVER (ACUTE PARENCHYMATOUS HEPATITIS)

Hyperacute Form. Acute yellow atrophy of the liver, also known as icterus gravis, acute parenchymatous hepatitis, malignant jaundice, parenchymatous degeneration of the liver or acute necrosis of the liver is the potential ultimate lesion to which any form of hepatic degeneration or hepatitis may progress. The literature contains numerous references to the fact that at one time or another examples of this progression have occurred in association with all the conditions described, e.g., toxic causes, as extreme phosphorous poisoning; acute infectious disease, as yellow fever or variola; syphilis; metastatic pyogenic infections, as erysipelas, osteomyelitis, puerperal sepsis, etc.; enterogenous cases, as those following cholangigis; autolytic cases; mushroom poisoning (oxford Medicine).

Pathologically, it is a widespread degeneration of the liver with toxic manifestations, jaundice and a reduction in the size of the liver. The term "acute necrosis" is more descriptive of the condition. It is known to occur at all ages and in both sexes, isolated from or associated with pregnancy. Since the first case of acute yellow atrophy of the liver in pregnancy described in Kerkring in 1706, most writers have referred to the relation of the disease to pregnancy. Rarely, it may be epidemic, as shown by Kent's series of fourteen cases which occurred in a period of eighteen months, all in association with pregnancy. Kent's series, however, lacks pathologic confirmation. In association with pregnancy, it is generally but wrongfully included among the toxemias of pregnancy as typical cases have occurred in man and in non-pregnant women also.[127]

A typical and severe form of the hepatorenal syndrome is, almost of necessity, part and parcel of the clinical entity. At postmortem examination the extent of the degeneration and necrosis in both liver and kidney is of maximum grade. This should be expected in view of all of the facts outlined on a previous occasion.

One cannot avoid the conclusion that acute yellow atrophy of the liver may be a primary condition or the terminal phenomenon of a variety of other conditions; that the lesion is essentially the result of the toxic action of a variety of agents; that all of these produce necrotic and/or degenerative changes, sometimes in the liver alone and more frequently in conjunction with the kidney; and that the degree, extent, magnitude and relative proportion of the hepatic and renal lesions, extending from those of least clinical importance to the maximum dramatic manifestations of acute yellow atrophy and hepatorenal insufficiency, are questions of the dosage and intensity of poison or toxin delivered in the environment of the hepatic and renal cells.

Toxic Hepatitis. There is a less hyperacute, even though frequently fatal form of the disease which is variously known as acute hepatitis or toxic hepatitis. Hepatitis in the sense of evidence of infection is not the predominant lesion, but rather extensive fatty degeneration of the central portions of the liver lobules without actual necrosis or atrophy. Fatty degeneration of the liver seems to be a more descriptive term. The onset and the usually fatal clinical course are identical with those of true acute yellow atrophy, and the location and type of lesion, that is, fatty changes in the liver cells in these central portions of the lobules, are the same. Although the liver cells in these areas are not disintegrated, that would seem to be a matter of degree rather than of kind of disease. Whitacre and Fang[127] consider this condition as an early stage of acute yellow atrophy.

Obstetric Acute Yellow Atrophy. One of the clinical forms of "toxic hepatitis" occurs in pregnancy and is known as "obstetric acute yellow atrophy." True yellow atrophy is very rare in pregnancy. Among Bergstrand's[139] seventy-two cases there was none in a pregnant patient, and in the last 400 postmortem examinations on pregnant or puerperal women in the Glasgow Royal Maternity Hospital there has not been a single example. It would appear that true yellow atrophy of the liver is so uncommon in pregnancy that it can be looked upon as a chance complication.

Obstetrical acute yellow atrophy appears to be a definite entity. Clinically, it is very similar to true yellow atrophy, but is sufficiently distinctive to make differentiation of the two diseases easy. Sheehan's[111] description is based on six cases found in the last 400 obstetrical postmortem examinations.

At autopsy the patient is deeply jaundiced. The liver is yellow and rather small. Its lobular pattern is not lost. Microscopically, all the cases showed an identical lesion; there was a gross fatty change effecting the entire lobule except a sharply defined rim of normal cells around the portal tracts. The affected cells were bloated by a fine foam of tiny fatty vacuoles throughout the cytoplasm. The nuclei were normal and there was an entire absence of necrobiotic change. The liver lesion does not show any histological similarity to true acute yellow atrophy; there is an entire absence of necrosis in the obstetrical cases.

The cause of the disease is not known. Clinically, the condition has to be differentiated from true acute yellow atrophy; toxic necroses of the liver by chloroform, atophan, salvarsan or phosphorus; catarrhal jaundice; and cholelithiasis.

Subacute and/or Mild Form—"Healed" Forms. Classical acute yellow atrophy of the liver as described pathologically by Rokitansky[99] and clinically by Frerichs, also occurs in a mild form, which may produce none, or very few symptoms during the acute stage but ends in productive interstitial changes. This fibrosis is of a special type somewhat resembling alcoholic cirrhosis and often mistaken for it. The histologic characteristics of this type of cirrhosis have been described by Mallory,[72,73] To it he has given the name of "toxic cirrhosis." The late or "healed" stage, represents an actual chronic interstitial hepatitis in a clinical as well as a pathologic sense. Clinically, the picture is varied. Even jaundice and ascites may be absent. Mallory's investigations have furnished the connecting link between acute liver atrophy and a definite type of chronic interstitial hepatitis.

In spite of its very acute character and extensive destruction, Wilson and Goodpasture[128] do not suggest that the clinical forms of acute yellow atrophy are end results of extensive central necroses, like those which may occur following intoxication with chemical or other poisons. The lesions are essentially focal in character, do not affect the hepatic lobules uniformly, and are relatively large; there are areas of complete destruction of parenchyma interspersed with other larger or smaller relatively unharmed areas, which in time become hyperplastic. The process differs in this respect from the effect of known toxic chemical agents and suggests the presence of some local disturbance in the liver, irregular in its distribution, as an essential or contributing factor.

It does not seem justifiable, however, to diagnose and distinguish the condition of a healed liver as "toxic cirrhosis" as opposed to "acute yellow atrophy," if by that term is meant the healed end result of a central necrosis of the type so commonly seen as a terminal event after certain severe infections or after chemical poisoning. Wilson and Goodpasture[128] suggest that acute yellow atrophy should be considered as a distinct disease with characteristic acute, subacute and chronic stages, as emphasized by Strumpell,[141] Seyfarth[142] and Brütt,[143] and they consider the term "healed stage of yellow atrophy" a preferable one.

Localized Forms of Hepatitis. Localized forms of hepatitis are found most commonly in association with acute inflammatory conditions in the gallbladder when an hepatic lesion is demonstrable in the liver parenchyma for a short distance surrounding the gallbladder bed. The following lesions of the liver parenchyma have been described:

1. Interstitial or proliferative infiltrations localized chiefly in the biliary-portal spaces, and usually consisting of lymphoid elements with a few neutrophiles and occasional eosiniphiles. No vascular lesions are observed in either the portal radicles or the central veins. In only a few cases is there a proliferation of the biliary capillaries. The interlobular supporting tissue has always been found normal.

2. Less constant parenchymatous lesions usually manifested by slight, fatty cellular degeneration. Other changes are pigment infiltrations, protoplasm vacuolization, and nuclear changes. Necrosis and fibrous tissue changes have never been observed.

3. Capsular lesions are present in about 50 per cent of cases, manifested by a connective tissue thickening of Glisson's capsule.

Contrariwise, I have seen a number of instances in which acute and chronic cholesystitis were present in livers the seat of a well formed cirrhotic condition as shown by the visible hob-nailing of the liver. Not only an exudative inflammation occurs, but various forms of degeneration, necrosis and regeneration, and various forms of productive inflammation, giving the most varied picture, extent, degree and character of interstitial and parenchymatous lesions.

The conclusion has been reached that in many cases of cholecystitis there has been a direct extension to the liver; that frequently a vicious circle exists between the gallbladder and the liver whereby each may reinfect the other; and that such infection of the liver is an important factor in the production of cirrhosis. This assumption seems to be supported by the anatomical fact that the gallbladder possesses a rich lymphatic network which pours its contents into a subserous network by lymph vessels which traverse its muscular coat,[144,145] and that the lymphatics of the gallbladder anastomose copiously with those of the liver.

Relationship of Lues to the Cirrhoses. The frequency with which a positive Wassermann reaction is obtained in cases of portal cirrhosis[65,117] raises the question of a more intimate relation between syphilis and portal cirrhosis, and Letulle[65] believes that ordinary cirrhosis may be due to syphilis. Nevertheless, syphilis has not been considered a direct cause of portal cirrhosis, the lesions recognized as due to the spirocheta pallida being quite distinct. The most that has been suggested is that after the cure of the early lesions the liver is left with its resistance so diminished that factors, which in ordinary circumstances would have been comparatively harmless, are now able to exert a sclerogenic effect.

Relationship of Tuberculosis to the Cirrhoses. The causal relation of tuberculous infection to the cirrhoses is not clear. In the uncommon case in which a certain amount of interstitial hepatis is found surrounding foci of tuberculosis, the picture is not that of the ordinary forms of cirrhosis. It is unlikely that there is any other connection than the usual scarring surrounding and resulting indifferently from most varieties of infection.

Miscellaneous Group. Some degree of hepatitis is very rarely associated with leprosy nodules in the liver,[18] and in leishmaniasis.[87] In the tropics there is a high incidence of hepatic interstitial fibrosis in association with diseases to those regions.

MIXED LESIONS

In the greatest number of the cases the dominating characteristics of the anatomical picture are sufficiently characteristic to permit a relatively easy classification of the individual instance. Nevertheless, there is occasional difficulty owing to the mixed character of the lesion which presents itself. This takes the following forms: (1) The essential lesion seems to be the atrophic type of Laennec (interlobular type) in which areas of the hypertrophic type of Hanot (intralobular type) are present. (2) The exact antithesis of the first group is present. (3) The essential anatomical picture is so distorted that no area of definite type is present, and in which the connective tissue change is unorganized. (4) The picture contains areas conforming to all of the above classification.

PATHOLOGICAL ANATOMY

PRIMARY HEPATIC CELLULAR CHANGES AND DEGENERATION

In all cases the most frequently found factors are fatty infiltration and degeneration and the use of alcohol. For this reason it seems best to discuss the resultant pathological changes together.

Effect of Fat Infiltration upon the Liver Cell—Hyaline Degeneration and Necrosis. The process of dissolution in the hepatic cell is distinguished in the chronic cases by its insidiousness. In many cases, and this applies especially to alcoholics, the hepatic cells store up fat; the cell volume distends to an extraordinary degree and the process is then customarily known as fatty degeneration. This fatty change is the forerunner of the following changes which can also occur in the absence of excessive fat storage: There is first hyaline change; then the cell outlines lose their distinctness; later granulation may or may not appear; finally they are engulfed, or digested by the endothelial cells of the sinusoids and are completely lost from visibility.

The histological picture in the liver is a later stage of simple glycogen depletion. In the typical fatty liver as seen at autopsy, there is definite parenchymal swelling in the enlarged liver; the capsule becomes tense; and, when the condition has been present for some time, the latter loses its transparency, becomes thickened and unyielding. The surface of the liver reflects this physical condition of swollen intralobular parenchyma between unyielding interlobular septa, and becomes irregularly coarsely granular even in the absence of any productive interstitial changes. This pseudo-lobulation is especially marked during life when the liver is full of blood. The color is usually pale or yellowish red, depending upon the amount of blood present. The lobules may be bile tinged. The consistency is variable but more likely to be firm and tense. Fat is abundantly present.

The hyaline degeneration and later atrophy occurs in the peripheral cells of the liver lobule and there is an early proliferation of fibroblasts. Gradually the final stage is reached in the typical hobnail liver. The gradation of the one into the other is unmistakable even into the final interstitial fibrosis. The absence of fat in many livers during the final stages is due to the dissipation of the body fat, to the discontinuance of the alcohol consumption and the resumption of a high carbohydrate diet.

McCallum's description of the repetitive destructive changes is as follows: "The liver cells are killed in patches—whole lobules and groups of lobules at a time, or only parts of lobules. There remain irregular masses of liver tissue partly disconnected from their bile ducts. The masses of liver-cells quickly increase in size by multiplication of their cells, new capillaries are formed in every direction, and this labyrinth of cells expands, pressing the stroma way on all sides. For a time the liver-cells are normal, but then comes another injury, and many of the hyperplastic nodules are partly destroyed. The whole process is repeated, and not only once, but many times. It is clear that this must lead to an extraordinary distortion of the liver's structure. There are no longer lobules, but only nodules produced by the hyperplasia of smaller groups of cells which were left intact."

The changes occur so slowly that many years pass while they take place. Mitotic figures are infrequently seen and there are no perceptible signs of activity in the neighboring bile ducts. There is never any hemorrhage and never any signs of acute inflammation. There are little, if any signs of cell regeneration. The picture most often involves the liver as a whole. It is distinctly not the picture of an overwhelming of the liver parenchyma in whole or in part by some extraordinary lethal agent so that the individual cells are quickly killed, i.e., undergo acute necrosis.

Rôle of Cellular Anoxia. It appears that whatever the primary single or multiple causes of this abnormal biological mechanism may be, the fundamental final provocative cause of the degenerative changes is intracellular lack of oxygen. In the very stages when fat is being accumulated in the liver cell to the exclusion of, or, more, rarely, in addition to the normal glycogen content, the cells in the liver cords, because of their abnormally swollen size, compress the nutrient vascular channels (hepatic block), interfere with the normal discharge from the cells of their katabolic products (bile secretion), prevent the replacement with adequate supplies of new metabolic material, and create an environment of decreased oxygen tension and a consequent sluggishness, inhibition or change of intracellular activity. In the later and final stages of this process, anoxia of the hepatic cell is increased by the throttling effect of the contracting scar tissue. Clinical disturbances become more marked then and changes in function as shown by functional tests appear and grow more decisive. In this stage very little regressive change can occur; but if nutrition and oxygenation of the hepatic cells can be sufficiently increased, the process may be prevented, at least for a time, from increasing to the final stage from which no recuperation can take place.

Himwich[31] et al. concluded that the altered metabolism which they found after alcohol administration (increase of lactic acid, increased carbon dioxide, change of hydrogen ion concentration to acid side, and increase of sugar in blood) was due to an inhibitory effect on cellular respiration. These effects are similar to those produced by ether, chloroform and carbon tetrachloride, and it is noteworthy that the experimental cirrhoses of the liver which most nearly approach alcoholic cirrhosis was produced by carbon tetrachloride,[13 60] which has a depressent action on carbohydrate similar to alcohol, but a much more drastic action on the liver; and by phosphorus[73] which causes a fatty infiltration as well as a degeneration, of the liver.

DEVELOPMENT OF CHRONIC INTERSTITIAL HEPATITIS INTO ITS VARIOUS ANATOMICAL FORMS INCLUDING THE ATROPHIC TYPE LAENNIC (CIRRHOSIS)

Effect of Hepatic Cell Dissolution upon the Connective Tissue Framework of the Liver—Chronic Connective Tissue Proliferation. Sooner or later connective tissue proliferation begins somewhere in the environment of the lobules probably from the cells forming the walls of sinusoids. It is frequently more prominent around the portal areas. There is usually a thickening of the sinusoidal wall as the first noticeable collagen fibrils becomes swollen, forming homogeneous thicker lines of collagenous material, and a delicate reticulum can be seen to form around degenerating cells. Fibrolastic proliferations follows the fibrous strands thus formed, connect collapsed empty capillaries (sinusoids) with one another, eventually joining with prolongations from periportal connective tissue. In the average slowly developing case these strands more or less clearly define the limits of a lobule. The strands join with others coming from any direction and sometimes cut across lobules, forming the irregular lobulated pattern that has been so hard to explain.

Productive changes in the connective tissue framework continues equally slowly. Inasmuch as under these conditions whole lobules are uniformly involved, there is evidence of this accompanying change only between the lobules and not in and among the individual hepatic cells in the interior of the lobule. They are first seen in the connective tissue septa and on the peripheral rim of the individual lobules, and in the early stages of this progressive accumulation of fibrous tissue, the bulk of the entire organ increases. This is the stage in which on physical examination the lower edge of the organ can be palpated much below the costal rim. As the septa and especially the perilobular new fibrous tissue formation increases in thickness, firmness and strength, contraction of the latter occurs and whatever is encompassed within it is throttled. The remnants of the hepatic cells are now further compressed and causes, or enhances, in addition to the primary degenerative process, atrophy and shrinkage of the entire organ. The hobnail appearance of the liver is characteristic of this change. Clinically, this appears as an abnormally small liver and indicates a far advanced phase of the disease.

An unmistakable gradation from the earliest changes to those far advanced is manifest in this mechanism of production of chronic interstitial hepatitis. The absence of fat in many such livers at the end is explained by the exhaustion of body fat, by the discontinuance of alcohol consumption, and by the resumption of a normal or high carbohydrate diet.

Demonstrable Transition Changes. It is a rare event for the changes which eventuate in progressive hepatic fibrosis to be demonstrable. In fully 80 to 90 per cent of the cases, there is usually no violent upheaval and destruction of hepatic parenchyma; and the symptoms are associated with a manifest sluggish, progressive lesion and with a process already far advanced. In the remaining 10 to 20 per cent, the process begins in some clinically recognizable episode of some form of acute hepatic destruction: acute hepatitis, acute yellow atrophy, toxic hepatitis, etc., and the subsequent course of events is as follows: In many of the instances the initial acute hepatitis (e.g., acute yellow atrophy) is such an overpowering episode as to result in immediate death; in some at least, of the other more fortunate ones, the acute disease is a single, not repeated incident (as, for instance, in some of the pregnancy cases) from which complete recovery follows; and, in the remainder, the symptomatology is so mild in the succession of episodes, that unless one is on the lookout, the cases escape notice and their occurrence is not recorded.

Nevertheless, in the latter, it has been possible on a number of occasions to demonstrate and study the anatomical and functional intermediate changes between the acute and/or subacute stages and the later changes and results (i.e., the "chronic" or "healed" or "cirrhotic" stage). The available information is as follows:

The periods of observation range from a few months to several years. Marchand's case was of six months' duration; that of McDonald and Milne,[80] of seven months' duration.

Bloomfield[11] was able to demonstrate in two cases definite evidences of latent hepatitis, eight and eleven years, respectively, before clinical symptoms appeared. In this connection he demonstrated the latent stage as that in which there are abnormal findings; elevation of blood bilirubin and induration of liver or spleen without any departure from health.

Wilson and Goodpasture[128] report cases illustrative of an acute, a subacute and a healed yellow atrophy of the liver. They believe that immediate recovery from acute yellow atrophy is probably more frequent than is generally believed. In the healed stage the liver is grossly and irregularly lobulated. The hepatic parenchyma is represented by irregular masses of hyperplastic liver cells, which are separated by a vascular, collapsed stroma in which the skeleton of previous lobules persist to a greater or less degree.

A series of cases are recorded by Connor[20] which show the development both clincally and pathologically of the condition known as acute yellow atrophy of the liver into definite "cirrhosis" of the liver (toxic cirrhosis of Mallory) usually not distinguishable from an alcoholic cirrhosis. The clinical history included previous attacks of jaundice often with pain, fever, and vomiting, and at autopsy there was a very small, greatly distorted liver. This form differs from the Laennec type in which symptoms of portal obstruction, and little or no jaundice form the clinical features, and a larger, less distorted liver with portal fibrosis are the pathological characteristics.

Abramson[1] found ten cases of chronic hepatitis in men between twenty and forty-two years of age in hospital material exceeding 10,000 cases of internal disorders, the causes of which were not determinable. The majority of the patients had no history of a preceding acute hepatitis. The subjective symptoms were fairly uniform and the clinical features included dyspepsia, fatigue, listlessness and depression, increasing after physical exertion and without jaundice. The period of observation was between two and seven years. Treatment never completely relieved the symptoms. The prognosis was uncertain and the possibility of a later development of cirrhosis was entertained.

Krarup and Roholm's[57] examinations of twelve cases of severe, protracted or recurring hepatitis were based on biopsy examinations and disclosed a gradual transition from the usual acute hepatitis to a fully developed Laennec's cirrhosis. Decidedly chronic changes appeared in the more active cases in the course of weeks, or insidiously over a period of several years in the others. None of the patients in question were addicted to the use of alcohol.

Whiteacre and Fang's[127] experience, also based on biopsy evidence, was the following:

The area of fatty degeneration involved three-fourths to four-fifths of the liver lobules in the first biopsy at the time when the blood chemistry indicated liver damage. The second biopsy showed intensive fatty degeneration which, however, involved only one-half of each lobule, and at this time, the chemical findings in the blood also indicated improvement.

Stander[114] reported a fatal case which was more severe but otherwise similar. One of the cases reported by Baens and Espinola also was similar.

Relation of the Distribution of the Connective Tissue Changes to the Localization of the Early Cellular Changes. In the various varieties of this condition, the localization of the cellular degeneration in the hepatic lobule has varied from the center of the lobule to its periphery. It is most likely that this is due to the path of approach of the causative agent (portal vein or hepatic artery and/or biliary passages) and/or the nature of the agent (bacterial, chemical and/or traumatic); less likely that it is due to a temporary or permanent change in the individual circulation, to a lessening of the effect of the causative agent as it progresses from the center of the lobule to its periphery or vice versa, to some other accidental distribution or action of the causative agent; or it is barely possible that it may have no biological importance.

The localization of the chronic connective tissue proliferative process occurs more or less in conformity with the character of the injury and with the localization of the area of degenerated or destroyed hepatic cells. In other cases in which an anatomically, or pathogenetically differentiated form of disease has occurred in the liver, the latter determines the distribution, character, extent and intensity of the connective tissue change. In either case, to be sure, the connective tissue change is clearly of a reparative nature, even though the objective is frequently distorted and replaced by other secondary effects as pernicious as the primary illness itself. Many of these forms of productive connective change are, therefore, unclassifiable. In only one of these forms, clinically usually associated with chronic alcoholism, the anatomical picture is clearly differentiated, i.e., the atrophic form of Laennec.

Degree of Connective Tissue Change. The relative amount of fibrous tissue in progressive cirrhosis of the "alcoholic" type was estimated by microscopic examination by Hall and Morgan[45] and recorded as slight in three cases (4.4 per cent); moderate in fourteen (20.6 per cent); marked in thirty-two (47 per cent); and extreme in nineteen (or 28 per cent). The stage of development of the lesion was judged by the maturity of the connective tissue and Hall and Morgan found fifteen cases (22 per cent) in which it was classified as cellular; eleven (16.2 per cent) in which it was classified as moderately cellular; thirty-seven (54.4 per cent) in which it was said to vary from moderately cellular to dense; and only five cases (7.4 per cent) in which it was designated as dense. The largest group (54.4 per cent) in spite of greater maturity, still showed evidence of fibroblastic proliferation, especially at the junction of fibrous tissue and liver cells and more especially about degenerating or necrotizing cells. The fact that fibrocytes are almost invariably found invading areas containing degenerating liver cells caused Hall and Ophuls to suggest that the toxic substance which destroys the less resistant liver cells serves only to stimulate the more hardy connective tissue to active proliferation.

Considerable variability was noted in the amount of cellular infiltration of the periportal connective tissue. In most instances, the greater proportion of cells consisted of small lymphocytes as in the chronic cases. In the subacute cases, however, almost regularly a moderate number of polymorphonuclear leukocytes were present as well. In a few cases they were quite abundant exceeding the number of lymphocytes.

Histological Characteristics of the Connective Tissue Changes. In the main, the histological variations of the cirrhotic lesion do not lend themselves to classification. In the livers of 590 cases of well marked cirrhosis, Mallory found 110 (18.5 per cent) atypical cases which he could not classify. Inflammation and irregular scarring develops wherever destruction of cells occur. Variously, the inflammatory process involves portions of lobules irregularly, and even surrounds single cells or small groups. But the lobular pattern in such cases is still recognizable. Sometimes the characteristics of the Laennec type of cirrhosis is replaced by that usually seen in the biliary type.

In advanced stages there are marked disturbances of the venous circulation especially in the portal radicals. Normally, the portal and hepatic venous systems divide in an arborescent fashion and the branches from each tree interlace regularly and end in fine dendritic branches which dove-tail alternately. This is characteristic of Laennec's cirrhosis.

Occasionally, the anatomical distortion results in obstruction of the smaller ducts. In most of the livers there is more or less bile retention appearing as. fairly large plugs in bile canaliculi, as very small dots of greenish inspissated bile, and collected as greenish masses around fat droplets within a liver cell. In no case has there been an extrahepatic block. The mechanism is obviously an intrahepatic cellular one, due to the intense and fairly rapid swelling of the parenchyma, and is most probably an inability to excrete bile from the hepatic cell into the bile canaliculi.

In the process of repair following repeated injury, all of the hepatic structures seem stimulated to extraordinary proliferation. The liver cells regenerate but their physiological efficiency seems less than par. There is also proliferation of the bile ducts and this sometimes approaches sizable proportions. There is interstitial activity as shown by the young fibrous and vascular tissue. Kupfer cells seem more abundant. Much of this has been shown experimentally and clinically, as indicated previously, in biopsy studies.

HYPERTROPHIC BILIARY CIRRHOSIS (HANOT)

The preceding factual summary pertains: (1) to an unclassifiable group of cases of the chronic proliferative connective tissue form of chronic hepatitis arising from a variety of known and unknown reasons and agents, in all kinds of people, and in a variety of conditions; and (2) to a demarcated clinical complex rather sharply distinguished anatomically as the atrophic (Laennec) type of cirrhosis of the liver. Both of these forms occur in older people; the first form usually, and the second form occasionally, can be produced experimentally in animals by injurious chemical agents of many kinds; and, clinically, the first form occurs as an incidental clearly recognizable reparative attempt in the presence of other differentiated lesions (parasitic disease, tuberculous and leutic infection, etc.), and the second form occurs in frequent association with chronic alcoholism. Both of these forms differ markedly, both clinically and anatomically from that rather uncommon form of cirrhosis which occurs in the young, and which is marked clinically and anatomically by enlargement of the liver with equal or more marked enlargement of the spleen and by a constant and persisting jaundice. The latter is the form usually referred to as the biliary, or hypertrophic form of, or as Hanot's cirrhosis.

Grossly, the liver is usually uniformly enlarged in this variety. The surface is finely granular, in contradistinction to the hobnail appearance of the Laennec lesion. The blood vessels and large bile ducts show no lesion; and bilirubin-calcium calculi are very rare. Gallstones are only occasionally present in the gallbladder, probably as a coincidental finding.

Microscopically, there is a delicate fibrosis surrounding the small bile ducts, some of which are obliterated and others dilated. The individual acini are no longer normally demarcated inasmuch as the further connective tissue proliferation 'occurs, either exclusively or to the largest extent intralobularly as opposed to the interlobular distribution in the Laennec variety. The liver cells are individually, or in small groups separated from each other by bands of fine fibrillar connective tissue which for a long time remain cellular, retain the early characteristics and do not shrink or contract. The enclosed liver cells are comparatively free from change in the early stages: later, they commonly contain pigment granules and fat, usually decrease in size, and sometimes show evidence of dissolution.

Around the periphery of the lobules there are new bile duct formations which stain brilliantly and are composed of cubical or elongated cells enclosing a potential lumen. They sometimes attain the size of, and simulate an adenomatous formation. The largest ducts are ordinarily empty and show no apparent change. The fine bile canaliculi seem filled with material; and the somewhat larger ducts are crowded with desquamated cellular and other material. Such evidences of a capillary cholangitis are commonly present. In experimental poisoning by toluylenediamin the small bile ducts become inflamed in an analogous manner, the process beginning in the biliary radicles. Experimentally, also, manganese, which is mainly excreted in the bile, gives rise to a biliary cirrhosis,[27] and Casomavor has reported a biliary cirrhosis in a fatal case of manganese poisoning in men.

The spleen is much enlarged, and may be larger than the liver. There may be perisplenic adhesions. Microscopically, there is fibrosis, distention of the sinuses with blood and endothelial proliferation of the pulp. The periportal lymph glands are enlarged and pigmented. The alimentary canal is free from inflammation.

In uncomplicated cases death is due to the gradual progression of the lesion and to a correspondingly increasing toxemia. A sudden acute degeneration of the liver cells, resembling that in acute yellow atrophy, may precipitate coma and death. Erysipelas is especially prone to attack these patients who may also succumb to other acute infections, such as pneumonia or peritonitis. The occurrence of exacerbations at shorter intervals indicates that the disease is advancing rapidly, and the incidence of complication renders the prognosis very grave. Widespread hemorrhages, edema of the legs, and ascites show that the end is approaching.

In contradistinction to the predominating toxic origin of the Laennec type of cirrhosis, it has been assumed that hypertrophic biliary cirrhosis is due to an ascending infection of the bile ducts. This has been denied by the French School because of the freedom from duodenal catarrh, the complete absence of suppuration which might be expected to supervene if this was the case, and because there is little in the way of any pancreatic infection which they believe should be present on the assumption of an ascending infection. Nevertheless, the fever and the concomitant enlargement of the spleen and sometimes of the lymphatic glands favor the causal relation of bacterial infection. According to Rolleston, the pancreas does show a fine fibrosis of the embryonic type. In any event, these objections to the infectious origin of the hypertrophic form of cirrhosis do not seem to be sufficiently conclusive.

Hypertrophic biliary cirrhosis may be closely imitated by the perilobular form of chronic interstitial hepatitis, by syphilis, by chronic splenomegalic hemolytic jaundice. Considerable doubt has been, therefore, expressed as to its being a separate entity, and Oertel denies any justification for so considering it. Nevertheless, the concept that the biliary intralobular form of fibrosis has a tendency to spread outward into the interstitial septa of the liver (perilobular form of hepatitis) seems to be justified by the picture seen in a tubal nephritis or nephrosis in which the latter is eventually complicated also by interstitial connective tissue changes. Furthermore, Rous and Larimore[105] have shown that the liver changes differ according to the level of any obstruction in the biliary tract.

DIFFERENTIATION OF BILIARY CIRRHOSIS FROM CHRONIC INTERSTITIAL HEPATITIS

All available knowledge points to the conclusion that the hypertrophic biliary cirrhosis of Hanot is not a succession of episodes as in the other varieties, more particularly in the Laennec atrophic variety, and that it has no etiological relation with them; but that it is a distinctive and sharply differentiated form of disease which has little or no interludes of remission, and which is a continuous progressive form from its very beginning until its very end. The further conclusion seems inescapable that this has to do with the biliary apparatus *per se*. A distinguishing characteristic of this variety is the splitting apart of the individual hepatic cells, as if the cement substance which keeps them in their normal anatomical relationship with one another and with the bile capillaries has been destroyed or, in some way, inhibited in its action. The connective tissue production here is most probably related to this intercellular separation.

COMMENTS

In clinical practice a breakdown can occur in persons whose hepatic structure and function had previously been apparently normal, or perhaps more probably, in persons in whom some hepatic damage had already existed as a multiple incident and in whom, in between these episodes, a partial or complete anatomical and functional recovery had taken place. Sensitization of the liver because of these repeated injuries, opportunity for which is sufficiently abundant in everyday life, renders the liver increasingly susceptible to the toxic damage and helps to explain the reason why some patients go through an overpowering fulminating course to death even after the first injury while others show mild, symptoms and eventually recover or possibly show no symptoms at all. A vicious circle is sometimes so produced.

The differences in duration, and in the manner of the development of this clinical and pathological complex, in the symptoms, in the suddenness and dramatic effect of the clinical mainfestations and in the rapid culmination in death, or in the more protracted course with apparent temporary improvement but, nevertheless, slow progression to the terminal stages herinafter to be discussed, or in the repetition of mild episodes with incomplete restoration to the normal in the remission periods and the passage into the terminal picture hereinafter to be discussed, seem to have important relations to the size of the dose of the causative agent, to the number and frequency of its repetitions, to the time limit in which the latter is delivered, to any intercurrent duct obstruction, and to various forms of preceding sensitization of the body to diverse toxic bodies. When the toxicity of the causative agent is sufficiently powerful and the latter is applied with sufficient intensity, the resulting hepatic injury is sufficiently large so that immediate death can and does occur. This is illustrated clinically in the acute cases of yellow atrophy of the liver of in those dramatic fatal cases of the hepatorenal syndrome which sometimes occur in the postoperative period after lightly undertaken operations upon the gallbladder and biliary tract for comparatively simple conditions apparently devoid of any undue risk and danger. From this easily recognizable hyperfulminant form of injury and disease, all gradations occur clinically down to those in which the evidences of disease are at a minimum and, sometimes even imperceptible to the clinician.

The initial stage of hepatitis may be clinically acute and promptly fatal. This group includes not only cases of so-called acute yellow atrophy, but also instances of a less violently destructive process which have been classified under the generic term of "toxic cirrhoses." These are, perhaps, the only cases in which a single episode of liver injury occurs and repetitions of the injury are prevented by the immediate fatal outcome.

An equally acute onset with an almost equally marked clinical symptomatology may rarely be followed by an apparently complete clinical recovery. In the usual run of case, this does not necessarily imply an equally complete anatomical healing and restoration of physiological function.

In other words, the liver damage may be so mild and ephemeral as to be unrecognizable unless one is on the lookout. In the latter cases, indications of the presence of disease are only to be found in changes of liver function or in the appearance of otherwise unexplainable jaundice. Any degree of jaundice occurring under such conditions is an indication of hepatitis even in the absence of any laboratory data.

After repeated episodes—and this repetition of episodes is undoubtedly the rule—latent anatomical changes and mild disturbances of physiology are present. The possibility of such increasing latent damage in structure or function which may gradually progress over many years until easily recognizable clinically, and until hepatic insufficiency eventually supervenes, is shown by those rare instances of cirrhosis in which a story of one or more previous episodes can be elicited. Such observations including the repetitions of these acute or subacute episodes, which, in between, subside again into latency have been clinically observed (vide supra); and such a cycle has been repeated a number of times before the patient dies. Blomfield points out the analogy between these long drawn out liver cases to the course of glomerular nephritis (Addis[2]).

Numerous experiments have shown that the liver has an extraordinary capacity for regeneration. Even after the removal of destruction of large portions of the liver, regeneration is accomplished by the formation of new lobules of normal size, shape, structure, character and vascular supply as shown by repeated biopsies and by laboratory tests of hepatic function. The architectural pattern in such regenerated livers is indistinguishable from that of a normal liver and no fibrotic changes follow.

This type of change and result usually can follow only a single relatively mild injury. It cannot and does not, however, follow a continued or repeated injury of a similar and/or, perhaps, of a dissimilar nature. Repetition, or continuation of the injury causes a chronic diffuse hepatic inflammation the essential features of which are degeneration and destruction of hepatic cells, regeneration of cells from those remaining, and subsequent attempts at repair marked by proliferation of connective tissue. Nevertheless, the conception that this is always synonymous with cirrhosis, as ordinarily understood, is somewhat erroneous even if it be so generally accepted.

It is very difficult to establish or even estimate the degree of anatomical restoration or functional recuperation either after a single or even after repeated parenchymal injury. And there is some evidence to show that in the present state of our knowledge, one may not lightly escape the thought that perhaps no complete anatomical and functional recovery ever occurs even after a single episode of injury or disease.

MECHANISM OF DISTRIBUTION OF THE PROLIFERATED CONNECTIVE TISSUE

Anatomy. There are important features in the vascular arrangement in the liver which are most pertinent to this discussion. While imperfectly understood, there is general agreement that the portal vein and hepatic artery spread out in an intricate capillary network which is intimately related to the liver cells.

The hepatic artery ramifies through the portal canals in the fibrous capsule of Glisson, forms a plexus outside each lobule, and appears to be destined chiefly for the nutrition of the coats of the blood vessels and bile ducts.

The portal vein also runs through the portal canals enclosed in Glisson's capsule, which finally break up into a plexus, the interlobular plexus, from which the blood is carried into the lobule by fine interconnected branches which converge from the circumference to the center of the lobule, and the walls of which are incomplete so that the blood is brought into direct relationship with the liver cells. The lining endothelium consists of irregularly branched, disconnected cells (stellate cells of Kupffer). Moreover, according to Herring and Simpson, minute channels penetrate the liver cells themselves, conveying the constituents of the blood into their substance. Arrived at the center of the lobule, the sinusoids empty themselves into the central lobular vein which after uniting with other similar veins to form larger and larger trunks, ultimately empty into the vena cava.

The blood capillaries of the liver lobule differ structurally from capillaries elsewhere. Developmentally, they are formed by the growth of the columns of liver cells into large blood spaces or "sinusoids." The Danish zoologist, Krogh, who has made most extensive studies, considers that the endothelium of the hepatic capillaries is a syncytium with numerous nuclei but without defined cell borders as in the embryonal capillaries, and that the star cells of Von Kupffer, which appear at rather short, regular intervals, are an integral part of the capillary wall. The English histologist, Schafer,[105] believes that what remains of the endothelium of the liver sinuses is represented by these stellate cells.

Distribution of the Proliferated Connective Tissue. The distribution of the proliferated connective tissue can be classified as follows:

1. In atrophic (Laennec) cirrhosis, the connective tissue is arranged in bands which includes multilobular segments of liver tissue, is mostly arranged along the lines of the original lobular framework of the liver, and follows along Glisson's capsule where the arteries, veins and lymphatics are found.

2. In hypertrophic (Hanot) biliary cirrhosis, the connective tissue proliferation occurs intralobularly and seems to have no connection as to localization with the distribution of the original liver framework nor with Glisson's capsule or its contained vascular and other structures.

3. In all other varieties of chronic interstitial hepatitis the distribution of the new connective tissue is irregular and has no clear connection with any of the essential liver structures: connective tissue framework, or vascular paths indicated above.

4. Specimens occur in which the proliferated connective tissue in the same liver shows the characteristics of all the previous three groups either mixed up together in a single area or segregated apart in various scattered areas.

Path of Action of the Causal Agent. It seems correct to assume the following deductions from the above facts:

1. The characteristics described in group 1 indicate that the causal agent acts along the vascular paths of the liver. This is supported by the further fact that the connective tissue proliferation has been demonstrably seen to proceed from the walls of the sinusoids.

2. The characteristics described in group 2 indicate that the causal agent has acted along the paths of the bile capillaries between the liver cells. In no other way can one explain the separation of the individual liver cells in the liver cords by the new fibrillar connective tissue. It seems correct to postulate that the direction of action may be in either direction, i.e.,

(a) toward the liver cell, and (b) from the liver cell outward in accordance with the secretion and excretion function of the cell. Because of the bacteriolytic function of the liver, it seems that bacteriologic infection can only be a retrograde phenomenon from the alimentary canal upward into the liver and this must be the mechanism of any cholangitic origin of the Hanot type of cirrhosis. On the other hand, the experimental reproduction of this type of cirrhosis, e.g., as with phosphorus, indicates that under certain conditions the Hanot type of cirrhosis could be due to agents secreted and excreted into the bile capillaries from the vascular channels through the hepatic cell.

3. In the numerous varieties encountered in this group, the connective tissue proliferation is related to the causal agent and its path of action. Thus in the case of toxic agents, it may follow the vascular channels, especially the portal vein, (heavy metals, chloroform, alcohol, etc.); in the case of bacterial infections, it follows more particularly the hepatic artery distribution and/or the lymphatic channels; in the case of other forms of disease, it surrounds these areas closely (lues, tuberculosis, hydatid and other forms of cystic disease, etc.). Under other circumstances it follows the distribution of the areas and segments of liver parenchyma which has been destroyed by the causal agent.

4. In this group the connective tissue distribution is undoubtedly related to a mixture of causal agents and their various paths of action and distribution.

In the majority of the cases, the poisons reach the liver by the portal vein and come from the alimentary canal. In a few instances poisons, and possibly microorganisms, from the spleen reach the liver by the splenic vein, as for example (a) in splenic anemia in which hepatic cirrhosis follows and constitutes a terminal condition usually designated Banti's disease, and (b) as in Egyptian splenomegaly.[98]

Acute and Chronic Cholangitis and/or Cholangiolitis. There are important clinical and anatomical relationships between acute yellow atrophy, biliary cirrhosis (especially the Hanot type), and the subject of cholangitis. Frequently the clinical manifestations are identical and equally often the anatomical pictures are indistinguishable.

All of the inflammatory diseases of the bile ducts are characterized by ascending infection, signs of occlusion and by changes in the parenchyma of the liver. In this respect cholangitis resembles the demonstrable phenomena in similar processes in the excretory channels of other parenchymatous organs.

Primary ascending biliary infection in the non-obstructed system of ducts is not a common occurrence except when there are abnormal connections between the gallbladder and gastrointestinal tract.

Cholangitis may be defined as an inflammatory process occurring in and around the walls of the intrahepatic biliary passages. Curiously enough generalized secondary infection of the biliary passages rarely occurs from systemic infection, from metastatic hepatic abscesses, or from pyogenic granulomas involving the substance of the liver. Strictly speaking, and on an anatomical basis, there is no true cholangiolitis. In the liver lobule the bile radicles are so devoid of structure that no inflammation can be recognized. Here the visible changes concern themselves with the lining liver cords whose cells actually form the wall of the bile capillary. In any event, the inflammatory process is limited to the environment of the duct system outside of the liver lobules. The pathologic lesions vary from simple "catarrhal" involvement of the lining epithelium to periductal fibrosis and thickening of the wall of the ducts, and lymphocytic and leukocytic collections in the connective tissue surrounding the portal spaces.

None of the minor grades of infection of the biliary passages, whether acute or chronic, are associated with a definite clinical picture, or at least with one that is generally recognized. Again it seems probable that many clinically recognizable instances of biliary infection are dependent on a low grade lighting up of a chronic infectious process in the ducts by episodes of biliary obstruction. The process is a diffuse one involving the whole liver; it consists mainly of periductal fibrosis with local collections of lymphocytes and proliferation of the terminal bile ducts.

The later stages of the more chronic types of cholangitis are largely masked by the signs of biliary obstruction. The combination of obstruction and infection of the biliary passages produces the maximal amount of injury to the hepatic parenchyma, varying with the degree and duration of obstruction and with the extent of the pre-existing, accompanying or subsequent infection. In relatively acute complete obstruction, the common duct is usually not dilated and infected. Cellular activity become so suddenly inhibited that no excretion takes place and the duct lumina remain unchanged. In intermittent obstruction, however, dilation of the intrahepatic tree follows and may become considerable. It is limited by the presence of fibrosis in the wall of the ducts as a result of previous inflammation. The most striking change observed consists of active proliferation of connective tissue in and about the smaller bile ducts.

Under certain conditions, suppuration occurs in and about the biliary passages. Active suppuration in the biliary passages most frequently represents a lighting up of previous infection in the environment of the bile radicals. Because of the previously mentioned anatomical peculiarities of the ducts, suppuration in these passages represents an extremely serious and often fatal condition. The pathologic changes observed in cases of purulent cholangitis obviously depend on the previous state of infection and upon the degree of dilation of the biliary passages and on the virulence of the infection organism. In bile passages, which are already sclerosed and dilated because of preceding duct obstruction, the process may go on to a state of chronic suppuration. The intrahepatic ducts exude foul, turbid, purulent bile which contains calculous sand. Miliary abscesses about the finer bile passages often are a striking feature. Large, solitary abscesses may be a feature in the more chronic cases.

HEPATIC LYMPHANGITIS

In all of this discussion one may not pass aside the subject of lymphangitis of the liver

According to certain authors[15,16,25,28,56,70,118,124] the lymphatic paths of the liver originate within the hepatic lobules and according to Herring and Simpson,[49] Lee[64] and Gabrielle,[34] these pathways are intercellular spaces which do not possess an endothelial wall and do not extend beyond the interlobular area.

There is an extensive network of lymphatic vessels lying in the deep connective tissue layer of the liver capsule over the entire organ. From thence endothelial lined lymphatic vessels form a network in the connective tissue which continue into the capsule of Glisson, and around the ramifications of the portal vein, hepatic artery, and biliary ducts. The lymphatic network on the hepatic veins anastomoses with that which surrounds the branches of the portal vein.[64] These form the deep network. The superficial and deep networks in man are connected with each other by a great number of lymphatic trunks, more numerous on the inferior than on the posterosuperior surface of the liver (Baum) and are particularly numerous in the vicinity of the free anterior border of the organ.

The distribution of lymphatic channels around the grouping of portal and hepatic vascular radicals and around the biliary tree is very suggestive. The importance of lymphangitic involvement in all forms of liver infection cannot be overestimated and has hitherto not been sufficiently emphasized. In cholangitis, the process seems to be associated with lymphatic infection and it may be that the term "ascending infection from the intestinal tract" is in reality an ascending infection along the lymphatic channels. The occurrence of multiple small foci of suppuration in the liver parallells rather well similar small foci of infection that occur along the lymphatic channels in similar infections of an arm; and the subsequent periductal fibrosis would represent the healing stage of the lymphatic infection.

In toxic injury of the liver parenchyma secondary infections of very low grade undoubtedly supervene at some time in the biological development of the effects of the injury. It is most suggestive that the bands of fibrous tissue should follow along the ramifications of the contents of Glisson's capsule. Here, too, one may not lightly dismiss the rôle and importance of a low grade bacterial lymphatic infection.

Hepatic lymphangitis is, so to speak, the point of contact between biliary cirrhosis and cholangitis. Inasmuch as both of these clinically differentiated conditions eventually, if continued long enough, terminate in similar pictures of an intralobular form of cirrhosis, the point of contact is. most probably, the point of origin also.

Hepatic lymphangitis is also, so to speak the point of contact between acute, yellow atrophy and hyperacute forms of cholangitis. Very frequently, the clinical picture and the postmortem anatomical findings are indistinguishable. One may not escape the thought that a lymphangitis is an important factor in both of these clinically differentiated conditions.

Finally, one often speaks and hears of the difficulties of adequately draining an infected biliary tree. Nevertheless, this should be fairly easily accomplished inasmuch as the normal function is drainage. Again, one may not escape the thought that the difficulty in adequate drainage does not lie in the biliary tree, but in the surrounding lymphatic channels. These, indeed, are impossible to drain by any surgical means.

Many years ago, it was attempted to influence favorably the lesions of a Hanot type of hypertrophic biliary cirrhosis by a prolonged drainage of the biliary tree through the common duct. Drainage was always relatively free, but nevertheless, the condition did not better but became progressively worse. Again, one may not escape the thought that the anatomical area which it was necessary to drain, could not be reached through the common duct because it lay in the lymphatic channels.

SURGICAL CONSIDERATIONS

Degree of Hepatic Damage. In practical surgery, the importance of all of this lies in the extent of functional damage which all of this anatomical change brings about.

The degree of hepatic damage shown varies a good deal, while in general the anatomic changes are more or less proportional to the amount of hepatic damage. The amount of reserve which is left, from which one may attempt to determine the prognosis, is not usually apparent, demonstrable or measureable.

The best and most competent idea of hepatic damage must still be based on more or less purely clinical grounds. The many chemical and biological tests which have been proposed for the study of hepatic damage are bound up with tests of hepatic function. Dye excretion tests of many sorts and chemical tests based on metabolic change have been tried out and found not entirely satisfactory. In most cases hepatic function is demonstrably maintained by compensatory effort, as bile is still present in the stool, since there is no impairment in glycogenesis or any evidence of failure to deamidize the amino acids, in that urea formation is unhampered and a progressive increase of nitrogenous products in the blood is not observed. Nor is there present in the early cases the clinical picture of well established disease, marked by abdominal distention, vomiting, rise in temperature, oliguria, appearance of albumin, casts and red cells in the urine, increase of residual nitrogen in the blood, bleeding into the mucous surfaces, blood in the vomitus and the stool, and ascites or enlargement of the spleen.

A much greater degree of invisible pathologic change exists when jaundice appears.

The change is always physicochemical and indicates severe changes and a state of emergency. When superimposed on any of the demonstrable changes mentioned in the preceding paragraph, it indicates a long standing, perhaps usually an irreversible, pathologic condition. In many cases it indicates a terminal stage of the illness, and in any case a lack of hepatic reserve approaching the absolute.

INTERFERENCE WITH PROTEIN METABOLISM

The hypoprotinemia which accompanies chronic interstitial hepatitis is a most important item in the make-up of any of the advanced forms of disease. Just how much of a factor it is in the earlier stages of the disease has not been sufficiently established although there is reason to believe that some of it already is present.

The available facts regarding the relationship of the liver to the protein metabolism indicates that the central site of formation of the plasma proteins is the liver. The proofs of this are best established in regard to the plasma fibrinogen, and the liver is the sole site of formation for albumin. Most of the globulins are most probably formed in the liver, although there may be other sites for this also. The replacement of plasma proteins takes place from two sources, the ingested food intake and the reserve store of protein material.

After the amino acids reach the liver from the intestinal tract, they are built into proteins but a portion of this synthetized material is placed in the reserve store of plasma material, which is kept mainly in the liver.

Davis and Getzoff[22] distinguish the following varieties of hypoprotinemia: (1) Concomitantly with the insufficient nourishment, i.e., inanition which is apparent in the advanced case, there is a "prehepatic" form of hypoprotinemia due to the lack of supplied food. (2) As the function of the liver deteriorates, there is interference with the ability to synthetize plasma proteins, an "hepatic" form of hypoprotinemia. Infection seems to be an important item in this interference. (3) Should a loss of fully formed plasma protein occur from the body the third, or "post-hepatic" form of hypoprotinemia occurs.

With these facts in view two conclusions seem inevitable: (1) All cases of gallbladder and biliary tract disease, especially when operation is contemplated should be investigated as to the presence of any hypoprotinemia and, if found, the deficiency should be corrected; and (2) estimations of the hypoprotinemia might form a very accurate method of determining the function of the liver either alone or in combination with other tests. If the deficiency, i.e., the hypoprotinemia, should be uncorrectible, it undoubtedly would indicate an advanced disease, and/or an irreversible liver damage with loss of hepatic function and the gravest of prognoses.

As a corollary to all of this, Gyorgy and Goldblatt[40,41] point out that a sufficient protein content in the diet is important in the prevention of any deficiency of vitamin B (unidentified factor) and that the vitamin deficiency itself has caused, experimentally, an acute focal or diffuse hepatic parenchymal necrosis with an occasional diffuse periportal fibrosis. The importance of sufficient available vitamin B is therefore further emphasized.

As a further corollary to this, the impor tance of a luxury protein diet for the maintenance of adequate "anti-body matrix" (protein reserves) to serve as basic materials for specific antibody templation is in line with statistical evidence covering the increased susceptibility to infectious diseases observed as a result of dietary insufficiency.[17,26,68] The accumulated evidence emphasizes the importance of a "luxury" protein intake as a bulwark against infection (Madden and Whipple).

INTERFERENCE WITH BLOOD CLOTTING FUNCTION

In the presence of sufficient hepatic cell damage, the normal blood clotting function becomes disturbed. The abnormality is most marked when the subject has been jaundiced for some time, and, up to the present writing, this clinical fact has been the most expressive warning of the potential danger of postoperative hemorrhage. When there is reason to suspect before operation that there is previously existing hepatic cell injury and destruction, the blood clotting function should be thoroughly investigated by the available laboratory means, even in the absence of any jaundice and, especially so, when jaundice is *present; when found deficient, adequate* preparation with vitamin K, etc., should be carried out.

RENAL COMPLICATIONS (HEPATORENAL SYNDROME)

Degree of Renal Damage. Commonly such a complex condition is sooner or later associated with secondary renal changes (hepatorenal syndrome). It is impossible to say to what stage the hepatic disturbance must progress before clinical evidence of renal involvement can be obtained by functional tests, which, up to the present writing, are notoriously unsatisfactory.

Value of Renal Changes as a Measure of Hepatic Dysfunction. However, as I have pointed out, the renal mechanism furnishes a satisfactory means of detecting any preceding change in the liver; any significant change in the kidney could, therefore, in properly selected cases be employed, other things being equal, as a measure of any otherwise unrecognizable disturbance in the liver. This is the value of tests of renal function in the presence of liver disease.

When the manifestations of this syndrome appear, one must assume that they represent a continuation of the preceding functional and anatomic pathologic process. The development of the picture is rather slow, although usually, as complete dissolution approaches, an apparent hastening of the process and a more rapid development seem to take place. When the alarming symptoms appear after an operation, it is probable that a measure of bacterial infection has been introduced, which, superimposed on whatever else has preceded, becomes "the straw which breaks the camel's back."

Once this train of functional and anatomic disturbances begins, other factors come in to play, such as fever, shock, autolysis of tissue, anoxemia, anhydremia and azotemia. All of these aid and abet the primary agents or even each other, by producing conditions which are capable of creating, or are found associated with, *similar cellular degenerations in these* parenchymatous organs. As must be apparent, the amount of overlapping in the various manifestations of all the conditions discussed is enormous. A vicious circle, therefore, is produced, and the primary injury is enormously accentuated.

RELATION OF LATENT HEPATIC DISEASE TO THE PROGNOSIS IN PRACTICAL SURGERY

In practical surgery, usually the unexpected changes observed during operation indicate a fairly advanced stage of the previously existing disease. Nevertheless, recovery can occur from the immediate form of illness and from the prevention of any postoperative hemorrhage, in the employment of a different form of anesthesia, or in a change in the usual operative technic or procedure, which might help to obviate or lessen the immediate effects of the operative trauma, or the occurrence or effects of any resultant postoperative complication or event.

Practically speaking, the most important precautionary measure which is available is encompassed under the general provision of an improvement in the general nutrition. An abundant supply of carbohydrate must be combined with an adequate supply of protein. The latter is especially important in order to counteract the hypoprotinemia which is present. For the latter purpose transfusion of whole blood or of plasma, or the enteral or parenteral use of any of the various animoid preparations, in addition to adequate protein intake in the diet are necessary. From the latest available studies it seems that an adequate supply of vitamin B is also most essential.

SUMMARY

Operation upon the gallbladder and biliary tract is sometimes disturbed by encountering evidences of previous disease of the liver usually some form of chronic productive interstitial fibrosis. The surgeon must then be able to present to the patient the causal connection of this preceding change and the immediate and ultimate outcome to be expected.

Many causes contribute to the appearances of these changes and usually a combination of agents are present. They function by interfering with the nutrition of the hepatic cell, cause degenerations and necroses of the liver cell, and are followed by connective tissue changes taking the form of a perilobular fibrosis or less often by an intralobular disruption of the liver cords and an intralobular fibrosis. Nevertheless, recovery can occur from the immediate form of illness and from any operative insult. It should, however, endow us with caution in making any prognostic statement as it does not preclude recrudescences of injury with further advance of the process to an irreversible stage. In addition, it must be understood that the interstitial fibrosis itself may be productive of secondary effects as bad, if not worse, than the original injury. But in any event it must be understood that the chances are more than good that there will be further symptoms and that the patient will not be entirely well; and that there may be further serious disease eventually culminating fatally.

On the other hand, when the evidences of previous disease are so demonstrable, unexpected and frequently serious and even fatal events follow in the immediate postoperative period, or even shortly thereafter, after the discharge of the patient from the hospital, which is only understandable because of the preceding liver injury and damage.

In some instances it is possible to suspect before operation that previous liver injury had taken place as a consequence of which there are interstitial changes in the liver. When these are suspected and, possibly, corroborated by some of the tests of liver function, it becomes necessary to revise any previously held opinion regarding the risks of operation. The suspected changes might very well form serious objection to the performance of any operation of an elective nature. And in compulsory operations they might indicate a greater effort in the exercise of precautionary preoperative measures.

Some degree of hepatitis always appears. Commonly, it is difficult to establish the point at which these changes are recognizable clinically. The forms of acute yellow atrophy are the maximum ultimate manifestations to which all of these changes may lead. In between there are all gradations down to the most minor.

The initial hepatic injury may be immediately fatal, or recovery may take place with restoration of anatomical form and functional effort. Usually, however, there are repeated episodes. The more or less complete and/or successful attempts at restoration to the normal after the first injury become progressively less effective after subsequent and repeated injuries. Latent anatomical changes and disturbances of physiology, therefore, take place which sometimes are capable of being shown by tests of liver function; or they are called to one's attention by various grades of otherwise unexplainable jaundice. All of this has important relations to the character and size of the offending agent and to the frequency and number of the repetitions of these episodes.

To the surgeon, the importance of all of this lies in the amount of liver damage which is present. At the present writing, the best idea of this is based to the greater extent on purely clinical evidence. Latterly, the degree of hypoprotinemia and the degree of any interference with the blood clotting function have added some laboratory criteria to aid in this effort. And when, as is always the case, sooner or later, secondary renal changes occur, the demonstrable changes in renal function may be used as clinical indications of the amount of liver damage.

In practical surgery such unexpected operative discoveries indicate usually rather far advanced disease. Nevertheless, recovery from operation may occur; but it must be understood, that further trouble is bound to occur and that the patient will not be well; or unexpected and frequently fatal events may follow operation, the explanation of which lies in the preceding liver disease.

In some exceptional instances, it is possible to suspect before operation that such liver injury had already taken place; and when these are suspected, it may be possible to corroborate them by various tests. It then becomes necessary to revise any previously held opinion regarding the risks of the proposed operation. The suspected changes may very well form serious objections to the performance of any operation of an elective nature. And in compulsory operations, they would demand greater effort and care in the exercise of precautionary measures for the prevention of postoperative hemorrhage, in the selection of the anesthetic to be employed, or in the formulation of a different plan of operative procedure, in order to obviate or lessen any subsequent untoward postoperative event and/or manifestations. Of the precautionary measures, an adequate supply of carbohydrate, an abundant supply of protein—in the food, by transfusions of whole blood, or plasma, and by the use of aminoids—to counteract the usual state of inanition (hypoprotinemia), and the use of abundant supplies of vitamin B, are most essential.

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◆

CRYPTORCHIDISM

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CRYPTORCHIDISM is the term applied to a condition in which the testis does not enter the scrotum, owing to maldevelopment, anatomic abnormalities or other causation. There is as great a divergence of theories regarding the normal descent of the gonad, as there is of its non-descent or tardy descent.

It appears fairly well established that the embryonic testis begins its migration from the lumbar region to the iliac fossa during the third month of intrauterine life. During the fourth to the seventh month it remains at the site of the annulus inguinalis profundus and during the seventh month it passes through the inguinal canal. The eighth month finds it at the annulus inguinalis superficialis and in the ninth month, at or after birth, it comes to rest in its final bed—the scrotum. (Figs. 1, 2, 3, 4, 5, 6 and 7.)

Theories. Many theories seek to explain the rôle of the gubernaculum testis in testicular migration. The concensus among embryologists is that the gubernaculum, a fibromuscular band, is attached to the lower end of the epididymis above and to the scrotum at its nether extremity. It is maintained, therefore, that the descent of the testicle is due to contraction or atrophy of the gubernacular musculature. According to Lockwood, the gubernaculum terminates in five tails, the strongest of which determines the transit of the testis. Either it is drawn normally to the base of the scrotum or abnormally to one of four other sites, namely, (1) the region of the inguinal ligament directly medial to the anterior superior iliac spine, (2) the anterior aspect of the pubis, (3) the femoral or Scarpa's triangle, or (4) the perineum beneath Colles' fascia. (Fig. 4.)

Certain facts are frequently presented in contradiction to this theory. A pertinent fact usually ignored, and of transcendent importance, is that the gubernacular fixation is not to the scrotum proper, but to the lower portion of the processus vaginalis and the circumjacent fascial layer. Vanverts was, therefore, among the first to maintain that the gubernaculum is inactive in the descent of the testis. Furthermore, in the newlyborn child the testis, as shown by R. H. Hunter, can be drawn out of the scrotum and into the inguinal canal without pulling the scrotum along. Without fulcrumage it is inconceivable that the gubernaculum can exert traction on the testis. It was demonstrated by Burdach that testicular descent in a normal child occurs before the gubernacular muscle fibers are in evidence.

The recent amazing development of endocrinology in one regard has served apparently to explain the rôle of the glands of internal secretion in the descent of the testicle and the causation of cryptorchidism.

Classification. Cryptorchid patients may be placed in two categories, those with incompletely descended testes and those with ectopic testes. In the first the gonad may be found arrested at any stage in its normal descent, that is, at any level from the lumbar region to the upper portion of the scrotum. Why the testis completes its migration or does not is still unsolved. John Hunter held that the undescended testis was an imperfect organ and, therefore, did not migrate in a normal manner. Many investigators maintained, with Hunter, that a normal testis, if it did not meet anatomic barriers, would always reach its normal habitat in the scrotum. This belief appeared to be supported by the fact that the incompletely descended testis is usually small and its tubules poorly developed.

FIG. 1.

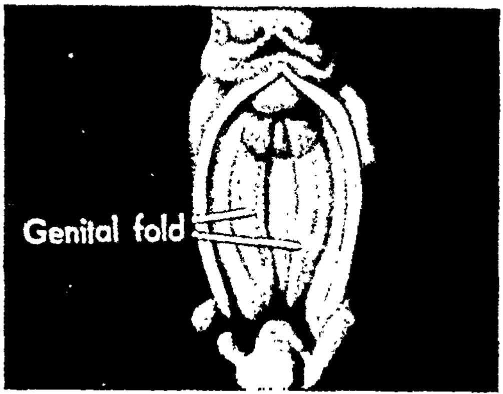

FIG. 2.

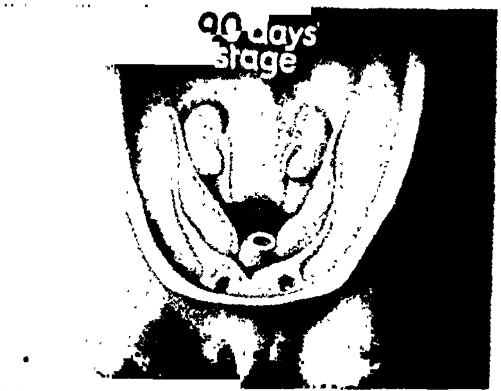

FIG. 3.

FIG. 4.

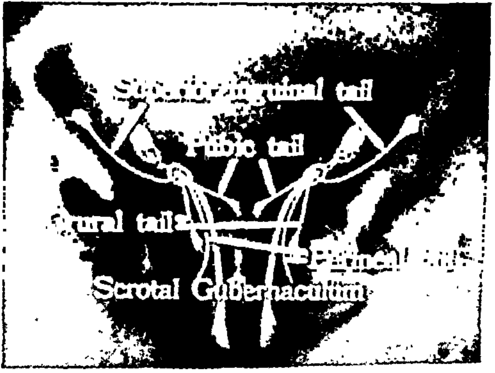

FIG. 1. Condensation of mesoderm, future testes.
FIG. 2. Testes prior to assumption of globular form.
FIG. 3. Testes at the deep inguinal rings.
FIG. 4. Various gubernacula which presumably guide descent of testes.

Opposed to this view are the data on undescended testes furnished many years ago by Sir Astley Cooper. He showed that the farther the pre-adolescent testis descends in its normal route, the more closely does it correspond histologically to the scrotal gland of the same age. This would indicate that the undescended testis is normal in structure, but not fully developed. Carl Moore proved that the scrotal low temperature is an absolute requirement for the complete development of spermiogenesis. The maldevelopment of the testis consequently would be the result and not the cause of its maldescent. In contradiction to Hunter's view is the added fact that until puberty, the cells of the cryptic gland retain their healthy pre-adolescent characteristics, even though the actual amount of parenchyma is reduced, which degenerative changes may begin after puberty.

Etiology. According to recent endocrinologic investigations incomplete descent may be due to one or more of the following causes: (1) Hypopituitarism, producing, as the term denotes, insufficient anterior pituitary gonadotropic stimulation of the testis; (2) primary hypogonadism, resulting in insufficient reaction to pituitary stimulation; (3) hypothyroidism, due to failure of primary tissue differentiation and lack of testicular response.

The gratifying results of hormone treatment of incompletely descended testes obtained by any physician confirm the belief that testicular function is under control of the endocrine system. (Fig. 8.)

In contrast to this type of cryptorchidism, the ectopic testis has a normal endocrine stimulus, but is arrested or "detoured" by purely mechanical factors and is, therefore, not amenable to hormone therapy. This displacement usually occurs after the organ has passed through the full length of the inguinal canal. It takes place in one of four directions: (1) The superficial inguinal region, where the testis lies lateral to the annulus inguinalis subcutaneous and in the plane between the aponeurosis of the external oblique muscle and the deep layer of the superficial or Colles' fascia. (Figs. 9 and 10.) (2) The pubopenile ectopic (rare) in which the testis rides in front of the pubis at the base of the penis. (3) The femoral ectopic, wherein the testis is found in the region of the femoral or Scarpa's triangle, near the saphenous opening. (Fig. 11.) (4) The perineal ectopic; the testis lies in a superficial perineal pouch under Colles' fascia, producing a swelling anterior to the anus, and lateral to the midline. (Figs. 12 and 13.)

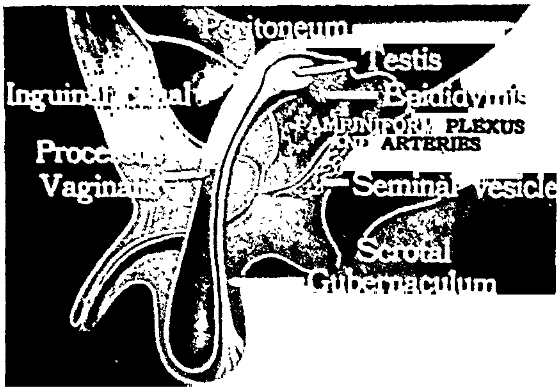

Fig. 5. Testes entering the inguinal canal about seventh month of intra-uterine life.

It should be stressed that the ectopic, unlike the incompletely descended testis, in addition to its normal size is usually accompanied by an indirect inguinal hernia. In children cryptorchidism may be apparent rather than real, for, owing to the spasticity of the cremaster muscle the testis may be displaced in an upward direction and thus be temporarily missing from the scrotum.

Reports vary concerning the histologic appearance of the cryptic testis, probably due to the fact that frequently little distinction is made between the incompletely descended, and the inguinal ectopic organ. Thus, in a report by Pace and Cabot of twenty-four cases of retained testis in the adult, including six in the third, and five in the fourth decade, all the inguinal cases presented some atrophy of the tubules and no increase in the interstitial cells. This prompted the authors to state that it was conceivable that each testis would regenerate an entirely normal germinal epithelium if it were placed in the scrotum. Likewise, DeWiniwater, after a study of two specimens of undescended testes from patients twenty-three and forty years of age, stated that the epithelium of the tubules was sufficiently preserved, so that the possibility of regeneration could not, with reason, be

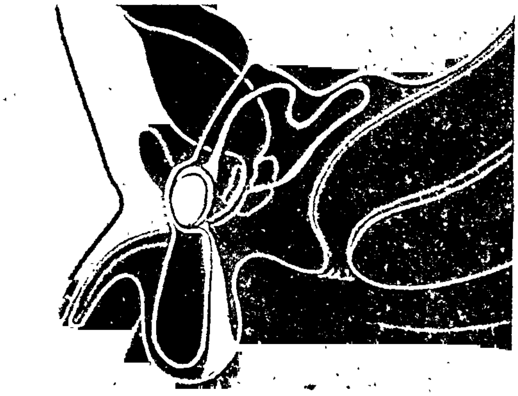

Fig. 6. Testes at subcutaneous ring about eighth month of intra-uterine life.

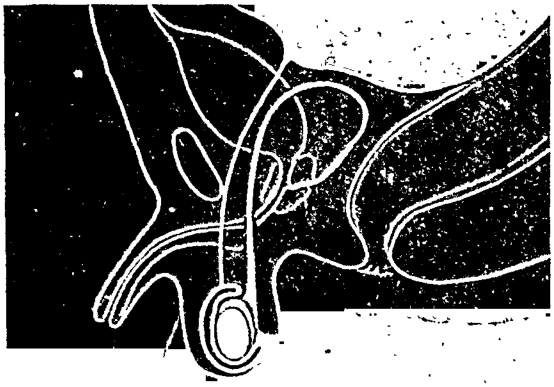

Fig. 7. Testes in scrotum at ninth month of intra-uterine life, normally closed processus vaginalis-ligamentum vaginale.

denied. In four cases of incompletely descended testis in patients between the ages of twenty and twenty-four, in whom the organs were of normal size, I found no atrophy of the tubules, but only slight spermiogenesis.

Treatment. Normally, until about the age of thirteen, little growth occurs in the testis, so that before puberty the histologic appearances of scrotal and undescended testes are similar. After puberty the ectopic testis may fail to generate a mature germinal epithelium because of the prevalent abnormal temperature outside the scrotum. Here, a mechanical factor, rather than an endocrine substance, determines the condition of the

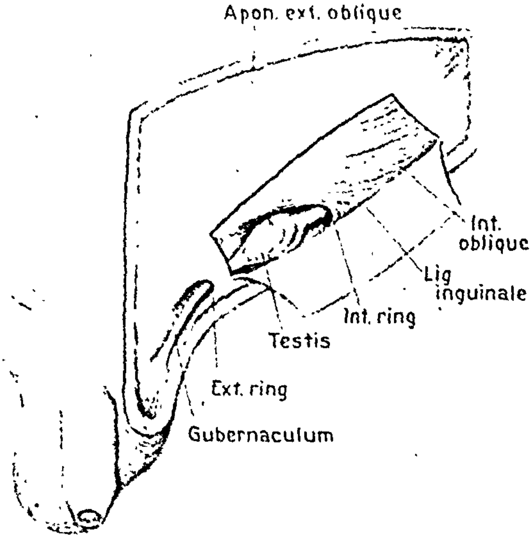

Fig. 8. Small incompletely descended testis; failure of descent probably due to inadequate endocrine stimulus.

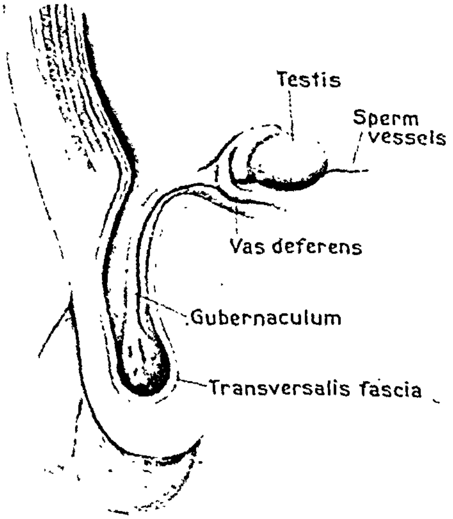

Fig. 9. Incompletely descended testis, normal in size; probably due to anatomic barrier rather than endocrine dysfunction.

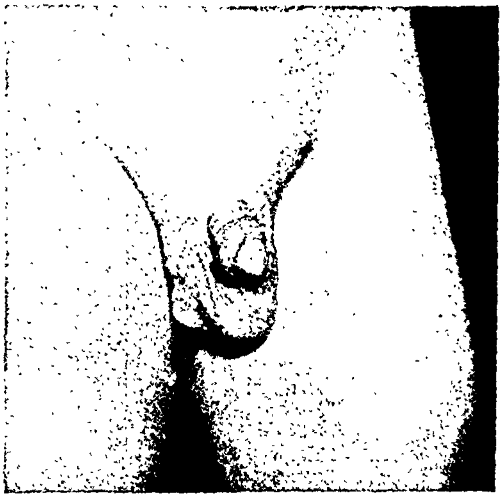

Fig. 10. Case illustrative of a type with a completely patent funicular process (scrotal hernia) in a child ten years old.

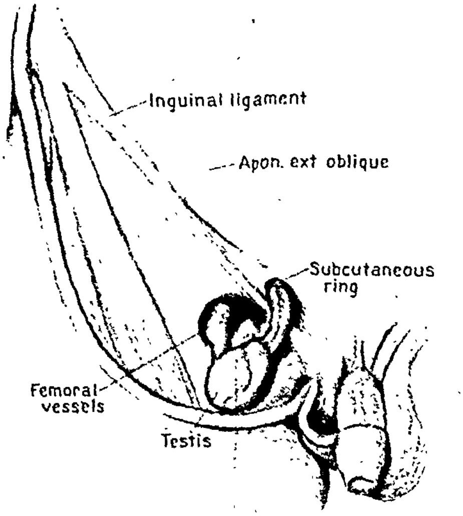

Fig. 11. Abnormal descent of testis showing congenitally displaced testis in the femoral region—ectopic.

testis. This distinction between endocrine and mechanical control is a vital factor in the treatment of cryptorchidism. The abnormal anatomic conformations obviously preclude satisfactory effects from hormonal therapy. This is of especial importance where the testis is contained in a congenital hernial sac.

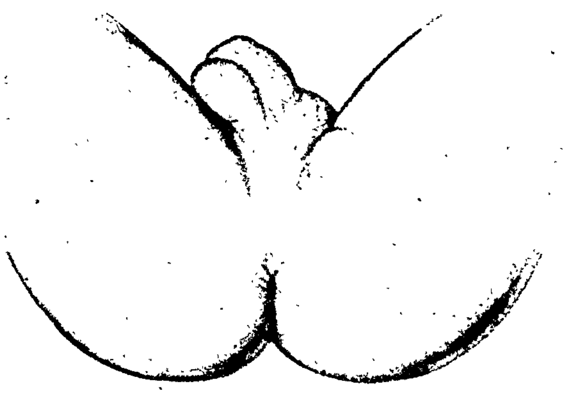

Fig. 12. Perineal ectopic testis.

According to Wangensteen, the size of the testis is a fair index of its eventual reaction after having been placed in its natural position in the scrotum. In a small atrophic organ the germinal cells probably disappear and no further development occurs, whereas, in a testis of fair size, in a patient past puberty, it is a reasonable assumption that young germinal epithelium capable of producing mature spermia still survives and that further development will occur.

It has been scientifically established that anterior pituitary hormone stimulates both testicular hormones—the spermatogenic and the androgenic. The undescended testis, as has been repeatedly shown, is defective in spermatogenic substance and must, therefore, be stimulated with anterior pituitary hormone. The urine of the normal child, for example, contains little or no anterior pituitary hormone, but the urine of children afflicted with cryptorchidism contains this hormone.[1] It has consequently been urged that these children with gonadotropic hormone in the urine should receive endocrine therapy before surgical repair is considered.

The following substances are employed in attempts to cure cryptorchidism: (1) The anterior pituitary-like substance which occurs in the urine during pregnancy; (2) extracts of the anterior lobe of the pituitary body proper; (3) pregnant mare's serum. In 1934 Haeussler[2] and Zondek[3] called attention to the fact that a stallion excretes enormous amounts of estrogenic hormone in the urine; that the amount of hormone excreted daily in the urine of the stallion is 400 times as much as that of a mature woman during one month. According to Zondek, the "testicle of the stallion proved to contain the largest amount of estrogenic hormone ever found in any sort of tissue. The mass excretion of follicular hormone is a property exclusively inherent in the male equines—horses, zebra, donkey—and is not encountered in other animals. It is possible, with the hormone produced in the male horse, to feminize other male animals—guinea-pigs—so that the mammary glands eventually secrete milk! This is probably one of the most paradoxical actions of the sex hormones. By using the hormone produced in the male horse, the well known antimasculine effect can be brought about in the testicle of other male animals." According to Zondek the urine of one pregnant mare yields an enormous quantity of hormone, as much as can be obtained from 1,500 women. Zondek quotes Girard[4] to

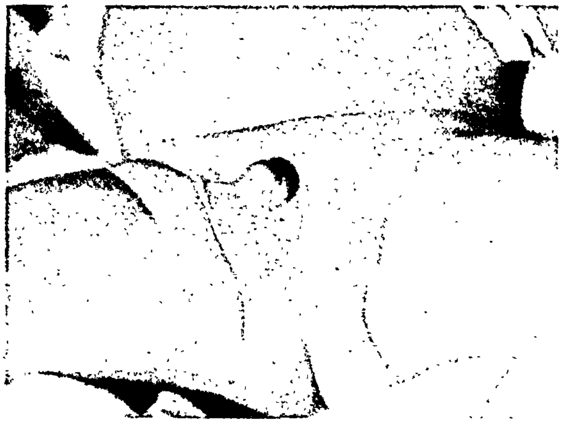

Fig. 13. Child four months old with a left perineal testis. Operated upon at one month for a strangulated right indirect inguinal hernia.

the effect that the latter investigator isolated from the urine of pregnant mares a few estrogenic compounds which are not found in human urine (equilin, hippulin, equilenin). (4) Testosterone propionate: (estrone, estrone-ester, estriol, estradiol, estradiol-ester). The results obtained with the use of these substances, aside from the affectiveness of the hormonal material, depends to a great degree on the anatomic factors: the length of the spermatic vessels of the vas deferens as compared to the length of the inguinal canal through which the testis must pass, the relative size of the testis and the tract, normal or abnormal development of the inguinal canal and scrotum, adhesions of the testis to contiguous or circumjacent tissues and abnormalities of the mesorchium.

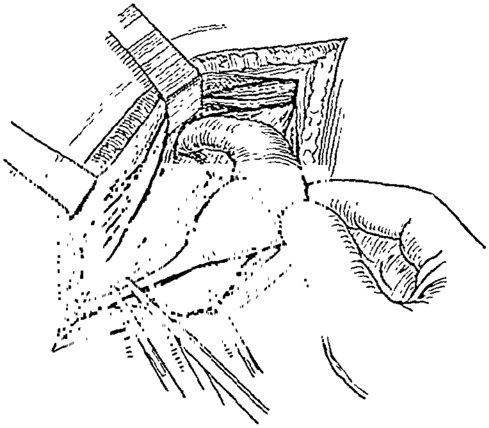

Fig. 14. Elevation of testis to permit dividing gubernaculum between two clamps.

Anterior pituitary-like substances are given intramuscularly in doses which vary from 200 to 500 rat units biweekly or once a week. This regimen is continued for a few months—two to seven—and if there is evidence of improvement a rest period may be advised.

Anterior pituitary-like hormone is the choice of available hormones in the treatment of cryptorchidism and poorly developed intrascrotal testes. The dosage should not exceed a total of 10,000 rat units administered for a period of sixteen to twenty-five weeks. Of my series, all patients with incompletely descended testes were treated with gonadotropic hormone. There were satisfactory results in six of these patients. In four others, complete descent was not attained but the size of the gland increased and subsequent surgery proved successful. There is a subsidence of growth when treatment is stopped. Atrophy never occurs as a result of this therapy. Aside from the enlargement of the testicle the endocrine treatment has, admittedly, a few dangers and the patients must, therefore, be strictly individualized. Thompson and Heckel[5] wrote that they "have been struck more by the influence of anterior pituitary hormone substance on the growth of the genitalia than by its influence on the descent of the testis." From this it would appear that the original incomplete descent was due to an endocrine and an anatomic influence, both of which had to be overcome in order to cure the cryptorchidism. Ten other cases were of the ectopic variety of cryptorchidism and excellent results followed early surgical

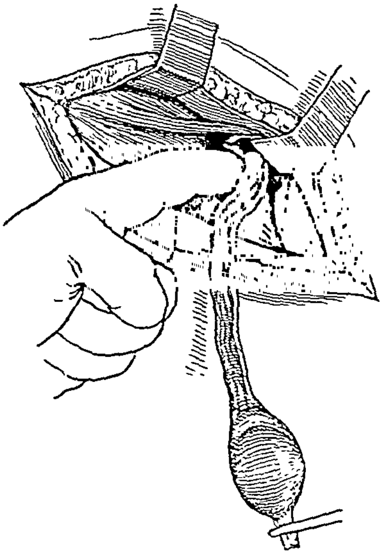

Fig. 15. Indirect hernia sac if present has been removed. Index finger is inserted deep into abdominal inguinal ring to release perivascular synechiae in order to elongate the cord.

intervention; the administration of glandular extracts would have been superfluous and perhaps harmful.

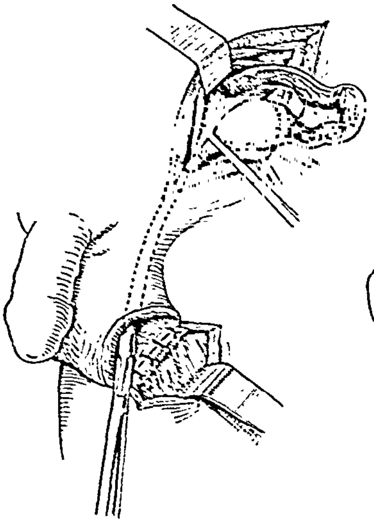

FIG. 16.

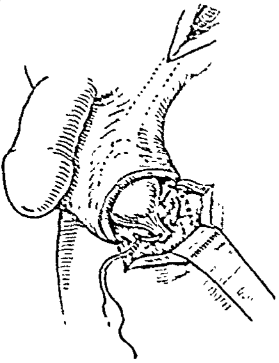

FIG. 17.

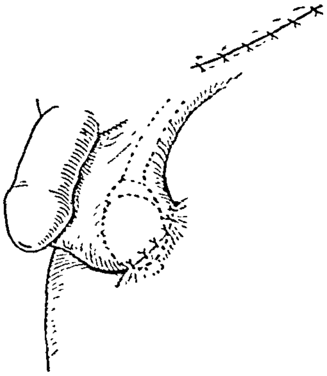

FIG. 18.

FIG. 16. Approximation of posterior margins of scrotal and thigh incisions. Gubernaculum is drawn down to lower incisions by a clamp inserted through scrotal opening.

FIG. 17. Suturing gubernaculum to deep fascia of thigh.

FIG. 18. Anterior margins of scrotal and thigh incisions approximated with black silk sutures to cover testis.

Surgical Treatment. The justification for orchidopexy is based on the following grounds: (1) When the testicle is placed in the scrotum, before puberty, it produces hormone and sperm. (2) A bilateral cryptorchid is sterile. (3) Statistical inquiries and studies have shown that malignancy is twice as common in the undescended testis. (4) It is more liable to tortion, strangulation, chronic inflammation and trauma. (5) Epididymial involvement of the scrotal testicle may leave the unilateral cryptorchid sterile, and (6) psychologic influences.

The surgical treatment of cryptorchidism may be begun at any age but preferably before puberty. However, it should not be discarded because the patient is beyond this age. Surgery should not be delayed in prepuberty patients. The sooner the cryptic testis is placed in the scrotum, either hormonally or surgically, the greater the likelihood of serviceable spermiogenic function.

I will refer briefly to the two-stage, modified Thorek operation for ectopic testis: The spermatic cord and its structures are visualized through the usual inguinal-scrotal incision. If a hernia is present it is treated in the customary manner by transfixion, high ligation and exsection of the sac. The testis is then elevated and the gubernaculum is divided between clamps and ligated to permit better mobilization. The vas deferens and its circumjacent structures are then located and a finger is inserted into the retroperitoneal space, as far as possible, in order to liberate adhesions which, if present, may bind the vas deferens and its blood vessels. (Figs. 14 and 15.) Sharp dissection will dispose of small fibrous synechiae. As a rule the vas deferens is sufficiently long to permit the testis to be placed in the scrotum. If the coverings of the spermatic cord and its vessels are too short, care must be exercised to avoid interference with the normal blood circulation when the testis is anchored. The deep insertion of a finger into the scrotum assists in the formation of a bed for the testis. This maneuver is not always a simple matter because the testis, having never descended, formed no hiatus. The insertion of the finger may be obstructed, likewise, by a continuation of Scarpa's fascia.

An incision is then made into the base of the scrotum. A parallel incision, about one and one-half inches long, is made in the contiguous surface of the corresponding thigh. The posterior margins of the scrotal and thigh incisions are approximated and sutured with everting catgut strands. The testis is brought through the lower scrotal wound by traction upon the gubernaculum which is transfixed to the deep fascia of the thigh. (Fig. 16.) It is anchored with plain or chromicised number one catgut on a round, pointed needle; care is taken to avoid the medial saphenous vein. (Fig. 17.) The testis is then covered by suturing the anterior marrins of both the scrotal and thigh wounds with silk or with catgut. (Fig. 18.) The inguinal wound is finally closed without transplanting the spermatic cord to avoid making undue traction upon the testis. Vaseline-gauze is inserted into the cleft above the newly made union of thigh and scrotum and the wounds are dressed in the usual manner.

The patient remains in the hospital about twelve days. Six weeks later he returns to the hospital for one day. The scrotum is now separated from the thigh, the gubernaculum dissected from the deep fascia and the scrotal and thigh wounds separately closed.

SUMMARY AND CONCLUSIONS

In incomplete descent of the testis surgical intervention is contraindicated, except in conjunction with endocrine therapy. In ectopy of the testis surgery is the method of choice and endocrine therapy, obviously, is unnecessary. If it is uncertain in which category a misplaced testis belongs a complete endocrine study should be made and correct hormonal therapy should be instituted. If there is an apparent failure of response, surgical treatment is justified, even if the gland is impalpable. Anorchism is extremely rare.

Table I

Total—100 Cases

Undescended	Ectopic
48 right	11 right
30 left	7 left
4 bilateral	
Co-existing Patent Funicular Process	
52	13
Results	
5 poor	1 poor
14 fair	2 fair
63 excellent	15 excellent

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ENDOCRINE FACTORS IN THE MECHANISM OF TOXEMIA OF PREGNANCY

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IN a collective review of the investigative efforts directed toward the elucidation of the fundamental nature of the late toxemia of pregnancy it will be observed that the positive results obtained in the confusing pathways of research are in inverse proportion to the vast amount of energy expended during the past few decades. In the search for the cause of the disease, up to quite recently the placenta was considered the principal factor in some way responsible for the disorder. The underlying reasoning pointed to the hypertensive-albuminuria syndrome as a specific condition peculiar to pregnancy and assumed that it is the presence of the placenta which essentially characterizes the pregnant state. As a corollary, the uniform decrease in blood pressure, albuminuria and generalized edema following evacuation of the uterus was cited as evidence of the primary seat of the disorder residing in the placenta. The occurrence in the overwhelming majority of cases of areas of degeneration and acute red infarcts in the toxemic placenta seemed to bear some etiological relation. Yet, the numerous sincere efforts aimed at the isolation from the placenta of certain consistently present and well defined substances "toxins," which would produce in laboratory animals hypertension and the characteristic lesions in vital organs as well as the alterations of blood chemistry turned out to be disillusioning exercises. The placental sex hormones, which from early pregnancy are found in the blood in concentrations far above anything occurring in the non-pregnant state, have in recent years received considerable attention. High chorionic gonadotropic content of the serum and certain changes in the relative amount of the constituents of the estrogenic fractions have been reported. No acceptable proof, however, has been adduced for the hypothesis which tends to assign to placental hormones the decisive immediate or indirect cause of toxemia of pregnancy.

The selective function of the chorionic epithelium was clearly established as a determining factor in fetal nutrition as long as three decades ago.[1a] There is likewise universal accord concerning the observation that at all periods of pregnancy syncytial fragments are constantly cast off into the maternal circulation from the chorionic villi whose exposed surfaces equal at term 6.5 square meters. Such placental derivatives, carrying various chemical substances which are normally stored in the human placenta, proved experimentally to represent the stimulus for the initiation and maintenance of the hyperplastic changes and the associated increased function of the endocrine chain—adrenal cortex, thyroid, pituitary.[1b] Increased amounts of thyroxin and free iodine in the blood (G. Curtis, Anselmino, Eufinger) and, histologically, the pattern of glandular thyroid hyperplasia have been established as regular attributes of normal gestation, as well as the hyperplasia of the adrenal cortex quite similar to the phenomena observed in Cushing's syndrome.[1f] Quite recently similar structural changes of the adrenal cortex have been found in the fetus, and extracortical secretion is being claimed in fetuses of toxemic mothers.[2] In recent years, in addition to the well known structural changes in the adenohypophysis increased secretion of the basophiles in the anterior lobe of the pituitary gland during the last trimester of gestation has been demonstrated.[3] Basically, it is the profound constitutional alteration resulting from these biological events which gives the pregnant state its peculiar stamp. With the placental stimuli in abeyance following the termination of pregnancy, the heightened activity of the endocrine chain referred to returns to normal and the hormonal imbalance, subsequently to be detailed as the dominant note in the mechanism of the late toxemia, readjusts itself. Furthermore, elimination of painful uterine contractions following the detachment of the placenta removes an active stimulus of postpituitary secretion as evidenced by the experimental observations of A. A. Danilov, Chang and Lim. These considerations, in conjunction with the recent denial of the etiological significance of placental red infarcts in toxemia by a number of competent observers (Falkiner, Fitzgibbon) indicate that we are obviously in the midst of a reorientation and a revision of the traditional and for decades almost axiomatically held doctrine which considered the placenta the cardinal factor in the etiology of the hypertensive toxemia of pregnancy.

Pursuing the train of investigation and thought originated in 1918 to the effect that in the causation of the syndrome termed late toxemia of pregnancy, consideration of hyperdynamic posterior pituitary principles may bring us within measurable distance of the realities of the situation, the pertinent data presented up to 1933 were collected and collated.[1b] The recorded experimental, morphological, and chemical facts relevant to the subject combined to afford ample proof for the view that it may be reasonably concluded that toxemia represents disordered autonomic physiology as the result of an undue posterior pituitary (pitressin) effect. Along this trend, efforts to identify in the blood an excess of the pressor-antidiuretic pituitary principle stirred much comment with denials of positive findings in late toxemia in preponderance. However, an overwhelming array of impressive facts buttressed the new tenet. The striking similarity between the cardinal features of blood chemistry in eclampsia and in experimental hyperpituitarism, notably anoxia of the tissues, the consistently present melanophore expanding principle in the blood in toxemia, as well as the corroborated clinical evidence of an increased susceptibility of toxemic individuals to pitressin, had first call. As quoted in a subsequent paper, in extensive studies Knepper was able faithfully to reproduce the well known lesions in vital organs in eclampsia by first parenterally administering proteins and subsequently pituitrin to laboratory animals, thus simulating the effect of the detachment into the maternal circulation of chorionic tissue, fetal proteins, which apparently sensitize the organs to the effect of pitressin.[1f] In addition, impaired excretory liver function during the second half of normal pregnancy occurring in 40 per cent of the cases studied, was considered a factor which may interfere with the normal process of detoxification of pitressin.[1c] Finally, atony and dilatation of the ureter known to be constant concomitants of gestation and usually amenable to the influence of the posterior pituitary principle are uncommon in preeclamptic toxemia, suggesting the effect of the pituitary factor.[1d] The well coordinated investigations of C. Mukherjee recently elaborated on the above aspects of the problem in a wider latitude and offered cogent evidence of increased concentration in the blood of the vasopressor, antidiuretic, and melanophore principle in late toxemia.[4] By small repeated doses of pitressin injected intraperitoneally Griffith produced in rats permanent hypertension[5] while Leimdoerfer observed the same effect with intrathecal injection of posterior pituitary extract.[6] The recent experimental studies of Netzel shed further light on the transcendent importance of pitressin in the origin of lesions in the liver and kidney in eclampsia, by way of vascular spasm and anoxia.[7]

Current interest attaches to the recent discovery of a dynamic equilibrium maintained during normal gestation between the opposing effects on the blood pressure of placental acetylcholine and a set of endocrine factors which conduce to intrinsic hypertonicity and augmented reactivity to vasopressin of the arterioles, i.e., overactivity of the thyroid, adrenal cortex, pituitary basophiles, associated with flooding of the blood with estrogenic and gonadotropic substances. Dislocation of this equilibrium in toxemia is reflected in the low acetylcholine content of the placenta as determined in twenty-eight cases, and the resulting inadequately opposed action of naturally secreted vasopressin.[1f] Damage to the storing capacity of the placenta has of late been demonstrated by Nixon and Wright, and Nisino[8,9] in regard to vitamin B and C and may justly be correlated with the universally recognized occurrence of degenerative placental lesions (J. Young) in late toxemia. A significant increase of cholinesterase in the toxemic placenta with rapid destruction of acetylcholine was stressed in a previous paper[1f] and received full confirmation at the recent meeting of the Am. Med. Association by R. Woodbury.* The admirable investigations of C. Heymans (Ghent), revealing the automatic regulation of the blood pressure by the action of pressoreceptors and their ready response to pressor changes and to acetylcholine, turn the limelight on data consistent with the above physiological approach which for simplification and clarity of the problem aims to convey a unifying concept of the pattern of the hypertensive toxemia of pregnancy. In this connection the recent information concerning the lowered rate of acetylcholine production in petit mal (Waelsch and Nachmansohn) is worthy of note, as well as the experimentally established fact that pitressin enhances induced convulsions while acetylcholine causes inhibition.[10]

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* A paper entitled "Influence of Neostigmine on Eclamptic Patients and Cholinesterase Activity of Normal and Preeclamptic Human Placentas" was presented by Dr. R. A. Woodbury and Lieut. P. H. Fried at the 1944 Convention of the A. M. A. This paper fully confirms my results published previously. By invitation I discussed Dr. Woodbury's paper and it was generally believed that the investigation concerning the true cause of toxemia has been put on the right track.

CRITICAL ANALYSIS OF MAMMECTOMY AND FREE TRANSPLANTATION OF THE NIPPLE IN MAMMAPLASTY

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MAMMECTOMY with free transplantation of the nipple was initiated to simplify the available methods of breast reconstruction. Some practitioners of this procedure do a complete bilateral mammectomy prior to the "grafting of the nipple." Others do a subtotal resection of the breast, including the central part of the gland and nipple. This paper will examine the indications for this method of mammaplasty in the light of present day knowledge.

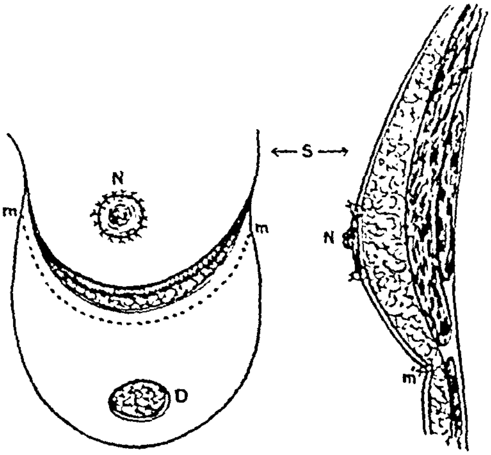

FIG. 1. Mammectomy with free grafting of the areola and nipple; D, defect following detachment of areola and nipple by sharp dissection; N, free areola—nipple graft sutured to a circumscribed denuded surface following removal of a superficial layer of derm; S, upper horizontal flap to be sutured in the submammary sulcus (*mm*) after excision of excess fatty and glandular tissue.

The procedure as outlined in the illustrations is as follows. (Fig. 1.) The areolae, including the nipples, are circumcised on each side and detached from the subjacent structures by sharp dissection. The free areolar graft, including the covering of the nipple, is then sutured to a circumscribed area on the anterior flap. Horizontal incisions are made on the anterior aspect of the breast, directly above the areola and in the submammary fold, through which the skin and all or most of the glandular tissue, including the nipple, are excised. The free edge of the skin flap is then sutured in the submammary fold. In either case the central part of the gland is sacrificed.

INDICATIONS FOR PARTIAL OR TOTAL AMPUTATION IN BREAST HYPERTROPHIES

The originators of the procedure[1,2] based its indications on the assumption that most of the methods described for the repair of large breast hypertrophies are difficult to execute. With regard to this question, the following data are pertinent:

The term, hypertrophy, covers both true hyperplasia of the mammary glands, which is rather rare, and other forms of breast overdevelopment, such as fatty hypertrophy, hypertrophy as the result of mastitis, and congenital asymmetrical hypertrophy in which one breast is larger than the other. It is important to distinguish between true hyperplasia and the ordinary oversized fatty breast, as the treatment and prognosis of these conditions differ radically.

True hyperplasia is characterized by marked increase in the glandular structures, with only a slight augmentation of fatty tissue. The hypertrophied breast of puberty is the most frequent type in this group. It attains enormous proportions, often extending below the umbilicus. This is frequently accompanied by disturbances of the general health. In this type of hyperplasia, in which the exuberance of glandular structures may border on malignancy, the safest procedure is subcutaneous amputation, after which the missing nipple may be camouflaged by free grafting of the areola or by tattooing a reconstructed protuberance of the skin simulating the nipple. (Figs. 1 and 2.)

However, by far the most common types of breast hypertrophies are due to excessive fatty degeneration of the gland, with glandular tissue scarce.

Another type is caused by mastitis. Here the breast consists of multiple fibrotic nodules or cysts of varying size and number. Among the congenital types of relative hypertrophies, the only abnormality common enough to warrant comment is mammary asymmetry.

Any procedure for plastic repair of a hypertrophied breast should rest on a sound anatomical, physiological and artistic foundation. The problem is not limited to reduction in size but involves such factors as permanence of result, postoperative function and distant prognosis.[3] The following are essential requirements: (1) The blood supply of the breast must be preserved. (2) The gland must be properly shaped and firmly affixed in a normal location. (3) Extensive injury to the galactophor ducts should be avoided to preserve as much mammary function as possible. (4) There should be no conspicuous scarring.

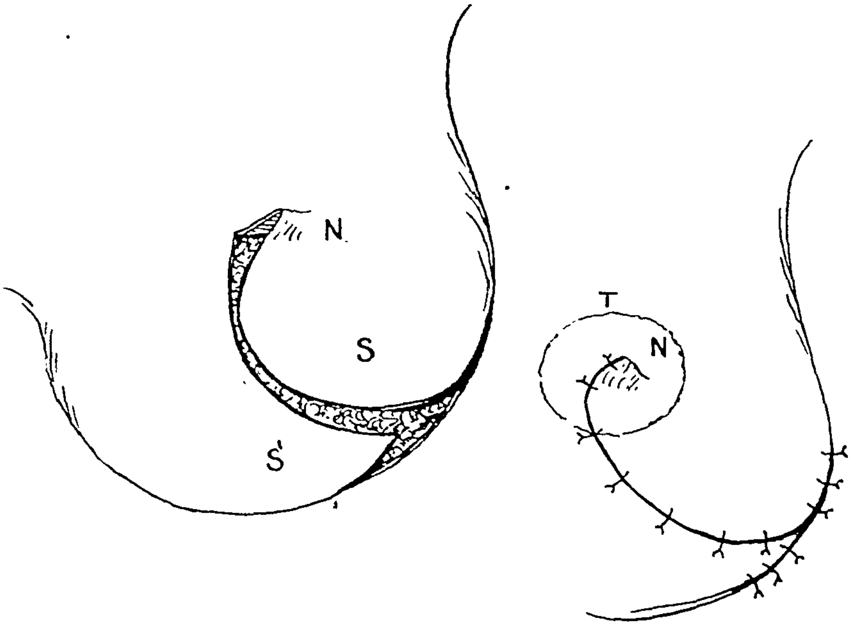

Fig. 2. Diagram showing rotation and folding of lateral flap, s, to simulate protrusion of nipple; s, skin flap rotated along the lateral lower quadrant; n, folding of flap at the level of nipple; t, tattooed area.

Mammectomy as a procedure of repair for benign hypertrophic breasts lacks all these essential requirements. Except in true hyperplasia, it should be condemned as a mammaplastic method because it is unnecessarily drastic and crippling, in contrast with a two-stage procedure, in which the central part of the gland including the nipple can always be safely preserved.[4]

INDICATIONS FOR FREE TRANSPLANTATION OF "NIPPLE" AND AREOLA

Following mammectomy, to camouflage the amputated central part of the gland, a free graft of the areola and "nipple" is supposedly transplanted on the anterior surface of the skin flap. From the illustrations furnished by the originators of this method (Fig. 1) it is evident that the areolar skin is superficially dissected together with the covering of the nipple. Under no circumstances can the nipple itself, in the anatomical sense of the word, be successfully transplanted free.

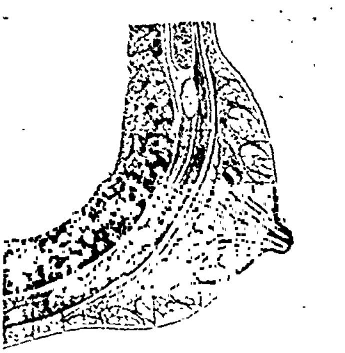

Fig. 3. Structure of nipple; dense areolar tissue with muscular fibers arranged in bundles through which pass the ducts. The nipple *in toto* thus cannot be transplanted free.

A few anatomical data on the structure of the nipple and areola are pertinent at this point. The normal nipple forms a hemispherical eminence in the center of the areola. It is a truncated cone, the surface of which is flattened, marked usually by pits or a multitude of minute, wart-like protuberances. It is covered by a modified integument that gives it a wrinkled or even a warty appearance.

Microscopically, the nipple is seen to consist of dense areolar tissue with numerous muscular fibers arranged in bundles, half perpendicular to the surface and half disposed circularly about the deeper structures. Erection and elongation of the nipple depend entirely upon contraction of the muscular element. The other characteristic structures are the ducts which pass through it vertically from the glandular tissue below. (Fig. 3.)

The areola is a well marked zone of pigmented skin surrounding the nipple. Its warty appearance arises from the Montgomery glands whose ducts open on its surface.

The anatomical construction of the nipple suggests that it can be preserved in mammaplasty only when it remains attached to the central part of the gland as in the buttonhole procedure, in which

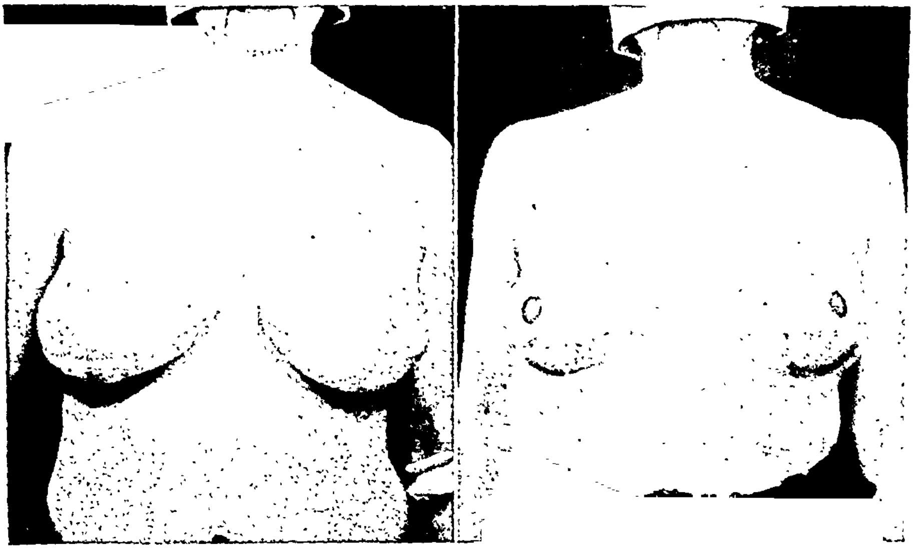

Fig. 4. a, deformity following mammectomy in a woman aged forty-eight done elsewhere twelve years previously for benign breast hypertrophy. The disfigurement was a source of great distress especially because of the loss of nipples, about which the patient was not advised prior to surgery. b, early condition following a secondary mammaplasty. Attempt was made to improve the shape of the breast by affixing the remaining mammary structures to the pectoral fascia in a higher position and removal of excess skin along a vertical incision above and below the old operative scar. The camouflaging of the nipple was done by producing a cone-like protuberance through folding the upper end of a lateral flap (Fig. 2) and tattooing the central segment of the breast.

the circumcised areolar skin is transplanted with the gland to a higher location.[5]

It is alleged by some that the freely transplanted nipple survives "if the proper technic is used." To those familiar with grafting of tissue, it is evident that it is impossible to transplant the nipple free by now available technics. Microphotographic illustrations of such grafts point to the presence of skin elements only. Proof of the possibility of free transplantation of the nipple would require microscopic evidence of muscular fibers and ducts obtained from sections of the transplanted tissue. Till now, such evidence remains lacking.

The free grafting of the areolar skin can be carried out to the same extent as the grafting of any other type of skin. However, the appearance of this grafted areola is far from simulating the normal contour of the nipple. In rare cases in which subcutaneous amputation of the mammary gland is indicated, as in true hyperplasias, the areolae can be used as free grafts on the anterior flaps; but the patient should be advised of the true facts of the procedure.

Patients in whom free areolar transplantation was omitted or has proved unsuccessful frequently apply for secondary repair. In such cases, the missing nipple can be camouflaged by tattooing the skin. In other instances a protruding cone, simulating the nipple, has been achieved by rotating the lateral skin flap through a midline incision; the protuberance is subsequently tattooed. (Fig. 4.)

SUMMARY AND CONCLUSIONS

1. Mammectomy, as a plastic method for benign hypertrophy, is a crippling procedure injurious to the physical and mental health of the patient.

2. The "take" of a freely transplanted nipple is technically impossible, as the ducts and muscle fibers will unavoidably slough. Freely grafted areolar skin usually "takes" in the same manner as any other type of skin.

3. To preserve, during mammaplasty, the vitality of the nipple, it should remain attached to the central portion of the gland. The procedure can usually be done safely in two stages.

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ULTRAVIOLET BLOOD IRRADIATION THERAPY (KNOTT TECHNIC) IN NON-HEALING WOUNDS*

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It is generally recognized today that there occurs in a very low percentage of individuals who have recovered from the immediate effects of wounds a failure in healing, despite the very best local treatment plus normal supportive measures such as infusions, transfusions, rest and adequate diet. This failure is apparently due to the absence in such individuals of a specific resistance factor, intrinsic in nature and of unknown character, often referred to as a general resistance factor. In any case, wounds do not heal normally in these few individuals as contrasted to the relatively rapid healing of wounds in most individuals.

Acting on the belief that a normal ultraviolet balance might be absent in such individuals and that a resultant ultraviolet deprivation might be closely connected with the absence of the necessary specific resistance factor which regulates normal wound healing, we have in the past five years applied to six individuals with non-healing wounds the Knott technic of ultraviolet blood irradiation therapy. The duration of the non-healing wound in each of these individuals up to the time of the use of this method varied from five months to six years.

In one of the individuals a non-healing fecal fistula was present; in two, multiple extensive non-healing lesions of the skin and soft tissues; in one a post-incisional failure of abdominal fascia and muscle to close despite several resuture attempts; in one a 3 inch by 3½ inch leg ulcer, and in one a non-healing amputation stump.

The rapid appearance of wound healing in and the recovery of all six of these individuals in a most convincing fashion has led us to believe that possibly ultraviolet deprivation played some part in the persistent failure of the normal healing process to appear in each instance.

CASE HISTORY ABSTRACTS

CASE I. Mrs. A. H. was first seen July 15, 1940, at which time her chief complaint was a discharging fistula from the terminal ileum, right lower side, approximately 7 cm long. She gave a history of an appendectomy in 1920, the presence of abdominal adhesions in 1922, acute abdominal pains in 1933 followed by the removal of a chocolate cyst of the ovary November 9, 1933. Two weeks after this operation an abdominal abscess was drained, and five weeks after the removal of the ovarian cyst an exploratory laparotomy was performed with negative findings. Shortly afterward a bleb appeared at the site of the laparotomy incision followed by a fecal discharge, and another laparotomy was performed at which time an enormous abscess was found and evacuated. Three months later she was discharged from the hospital with the fistula still open. In 1935, she was operated upon for three fistulas with a failure to close in all three. In 1936, while in Norway, fistulas were operated again with an evacuation of abscesses which had formed in the meanwhile. Since this, her last operation, she has had one fistula which closed for six months in 1939 but reopened and was draining freely when first examined here.

Physical examination revealed a highly apprehensive woman of thirty-three with an obvious fecal fistula in the right lower quadrant. A marked mental depressive state was noted as well as generalized weakness. Her temperature was 98.4°F., pulse rate 76, respiratory rate 18, blood pressure 96/60. Routine laboratory examinations were as follows: hemoglobin 14.6 Gm., red cells 3,650,000, white cells 11,100, urea N. 14, cholesterol 200, total proteins 6.62, total calcium 11.9, creatinine 1.6; Wassermann and Kahn tests negative.

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At this time the patient was told that her general condition might be benefited by ultraviolet blood irradiation therapy, that it was doubtful whether any healing of the fistula could be expected from this alone, and she was advised to have surgical repair of the fistula following four blood irradiations. The patient refused to consider operation at all, but insisted on having ultraviolet blood irradiation therapy which she was given for the first time on July 15, 1940. A few minutes later she developed a citrate chill which subsided rapidly.

Ultraviolet blood irradiation therapy was repeated on August 16, 1940 and by October 11, 1940, her general condition was greatly improved and a third blood irradiation was given.

On December 2, 1940, ultraviolet blood irradiation therapy was repeated. At this time the fecal fistula was found to be free of discharge and apparently healed. The fistula remained healed throughout 1941, 1942 and 1943, during which time ultraviolet blood irradiation therapy was repeated twice annually. Ultraviolet blood irradiation therapy was given last on January 22, 1944, at which time the patient was apparently in excellent health, and had suffered no recurrence of the fecal fistula which has now remained healed for more than three years.

Case II. Mr. V. A., age twenty-one, was first seen November 11, 1941. His chief complaint was a non-healing ulcer of the right leg which had occurred following a "floor burn" incurred while playing basketball in November, 1940. Physical examination revealed the patient to be in apparently excellent general condition, except for the non-healing ulcer which had slowly but steadily enlarged to the size of approximately 3 inches by 3½ inches. Application of various ointment and salve preparations had failed to promote healing over a period of twelve months.

After ten days' application of boric acid ointment which produced no change whatsoever the patient was given ultraviolet blood irradiation therapy. At this time laboratory examination, including serological investigation, proved to be entirely negative. At the end of five days tiny but definite granulation tissue was observed to be present at the base of the ulcer. In ten days the ulcer was approximately one-half its original size and fresh granulation tissue was abundant. In two weeks the ulcer had almost completely closed and complete healing of the ulcer was apparent by the twenty-fifth post-irradiation day. The ulcer had remained healed up to the time the patient was last heard from which was in November, 1942, approximately one year later.

Case III. Mrs. F. M., age thirty-nine, No. 63527, was admitted on July 19, 1940, with a provisional diagnosis of osteomyelitis. Her past history included a history of amenorrhea since January, 1940, and a doubtful liver abscess in April, 1937. Physical examination revealed a cachectic white female with a marked pallor and suffering from two discharging sinuses of the left thigh and one similar lesion of the right elbow. Her temperature was 99.0°F., pulse rate 120, respiratory rate 20.

X-ray examination of the chest was negative; *x*-ray examination of the right elbow showed evidence of a loss of 50 per cent of the olecranon process of the ulna, no evidence of activity at this time; *x*-ray of the femur showed no evidence of bone changes; *x*-ray of the left tibia showed condensing osteitis but no evidence of an active destructive process; further *x*-ray examination showed no evidence of dental disorder nor of destructive bone disturbances of the bones of the face.

Laboratory examination revealed the following: A negative urinalysis; negative Wassermann and Kahn tests; a negative Friedman test; 9.6 Gm. hemoglobin, 3,880,000 erythrocytes, 13,000 leukocytes with 71 per cent polymorphonuclears, 29 per cent lymphocytes; her sedimentation rate was 15 mm. at 15 minutes and 32 mm. at 45 minutes. Blood culture on July 22, 1940, showed Staphylococcus aureus, a possible contaminant. All attempts to find tubercle bacillus in the discharging sinuses were negative. A pathogenic strain of Staphylococcus aureus consistently was found in the purulent exudate of the discharging sinuses.

As a result of these findings many diagnoses were made including staphylococcus and tuberculous osteomyelitis, extensive subcutaneous cellulitis similar to that observed in lesions produced by a micro-aerophilic streptococcus, and a chronic Staphylococcus aureus cellulitis; the latter alone had bacteriological evidence in its favor.

On July 22, 1940, ultraviolet blood irradiation therapy was given by Dr. Alfred Tuttle. No improvement was noted at this time. The patient's general condition continued to deteriorate slowly.

A Mantoux test done July 30, 1940, was strongly positive. A gastric analysis done the following day showed no abnormal findings. Blood culture taken August 2, 1940, was negative.

At this time it was believed that the patient was also suffering from gallbladder colic and generalized arthritis. Despite the application of sulfanilamide and zinc peroxide ointment plus the application of generalized ultraviolet to the skin, the patient's discharging wounds became enlarged and her condition progressively worse. It was decided on December 20, 1940, to resume ultraviolet blood irradiation therapy as a general supportive measure, since the patient's general condition seemed hopelessly debilitated and her recovery had been judged to be highly doubtful. Blood irradiation was given at this time by Dr. Solon Boynton.

On March 11, 1941, blood irradiation therapy was repeated at the request of the patient who stated that following this treatment she felt generally improved, but the patient responded only very slowly in our opinion insofar as the draining lesions were concerned. Her general condition seemed somewhat improved and it seemed at this time as though she was for the first time out of immediate danger. The patient had required frequent pantopon and morphine administrations for severe pain throughout this period. She did not seem to respond to any therapy whatsoever at this time, although she had managed to survive somewhat longer than had been expected.

On May 31, 1941, ultraviolet blood irradiation therapy was given and the patient was discharged from the hospital with several discharging sinuses. At this time she stated that following blood irradiation she always felt stronger for several weeks, so she was advised to come back as an out-patient for this therapy. The final diagnosis on leaving the hospital was chronic staphylococcus cellulitis, chronic osteomyelitis, chronic arthritis, chronic cholecystitis, contraction flexures of both arms and both legs. At no time had any definite evidence of tuberculosis been found.

On August 19, 1941, the patient was brought into the blood irradiation clinic and ultraviolet blood irradiation therapy was repeated. She apparently was somewhat stronger, the lesions on both arms had healed although the lesions on the body and legs still were draining.

The patient was then given successive blood irradiations on October 10th and November 13, 1941 and January 9, 1942, on which latter date she gave a history of having had an abscess of the cervix incised and drained one week previous to treatment. Ultraviolet blood irradiation therapy was continued March 10th and May 6, 1942, at which time her skin lesions had almost entirely healed and her general condition was good for the first time. This therapy was repeated July 1, 1942, at which time the patient was ambulatory for the first time, although two skin lesions had reappeared. On September 9, 1942, one skin lesion of the leg remained, she was able to walk fairly well, and her general condition was still good.

From this time on blood irradiation was given the patient November 18, 1942, January 15th, March 30th, August 12th, October 19th and December 28, 1943, and March 7, 1944. During this period of time contraction deformities of both knees had disappeared as had that of the right elbow with the help of good physical therapy applied locally. All skin lesions have remained healed. The patient was able to resume a limited normal life with the exception of flexure contracture of the left elbow. Her sedimentation rate and laboratory findings have been within normal limits for more than one year previous to the time last seen which was March 7, 1944. All clinical signs of chronic cellulitis, chronic arthritis, chronic osteomyelitis and chronic cholecystitis have been absent for more than one year.

The rehabilitation of this apparently hopelessly incapacitated woman has been most satisfactory.

Case iv. Miss C. S., age twenty-eight, No. 56447, was first admitted to the hospital October 5, 1940, with the classical signs of high intestinal obstruction, and operation was performed for adhesions of the third portion of the duodenum as well as a band of adhesions from the lower ileum to the lower angle of a previous abdominal incision. The patient recovered quite well but a small area of necrotic skin remained between the old right paramedian incision and the new left paramedian incision. The patient was discharged on October 31, 1940.

On August 12, 1941, she was readmitted, and an elliptical incision was made around a draining sinus which reached down to the rectus fascia. Pathological examination of the specimen revealed a fistula lined by non-specific granulation tissue. The patient was discharged three days later with the wound still draining.

On October 8, 1941, this patient was again readmitted and the draining sinus was opened and packed by iodoform gauze, but this time the patient had become quite apprehensive, extremely depressed and had suffered from insomnia for the previous six months. Anorexia and a loss of weight were both present at this time. On October 15th she was referred to the blood irradiation clinic in the hopes that a general supportive measure might be of value. On that day ultraviolet blood irradiation therapy was given. The same evening the patient slept soundly for the first time in several months, and continued to do so until her discharge from the hospital October 18, 1941. Her general condition seemed to improve although the sinus to the rectus fascia which had been packed by iodoform gauze continued to drain.

A second blood irradiation was given November 22, 1941, and the patient's health improved enormously with a complete disappearance of anorexia, insomnia and weight loss which loss was regained completely in the two months following the first blood irradiation. The sinus failed to heal and we recommended that the patient have another surgical removal of the offending sinus on the grounds that since her general condition had improved so greatly it was entirely possible that wound healing would occur following complete removal of this sinus. The patient reluctantly consented to this further surgery, and on March 19, 1942, the sinus tract was extirpated. The postoperative wound healed completely and has remained healed for two years. The patient's general health has remained good.

Case v. Rev. M. W., age thirty-eight, No. 50625, was admitted to the hospital November 29, 1939, following an automobile accident. Physical examination revealed fracture of the right femur and severe lacerations of the right forearm involving the whole extensive surface of the forearm, with an associated severance of the extensor pollicis longus tendon. The tendon was repaired immediately on admission and healed quite well. The patient's general condition improved and he recovered from the acute effects of his accident fairly well.

In this patient, however, despite all known general and local therapy, there occurred a non-union of the right femur and a failure to heal of the extensively lacerated area on the right forearm. This condition persisted for approximately five months, at the end of which time ultraviolet blood irradiation therapy was recommended. On April 24, 1940, ultraviolet blood irradiation therapy was given this patient and within a week following this healthy granulation tissue appeared for the first time at the base of the lacerated wound in the right forearm. The wound began to close rapidly one week after irradiation and was healed completely in eighteen days. On March 7, 1940, x-ray examination of the right leg revealed, in comparison to the previous x-ray taken April 11th, a definite increase in the amount of calcification about the fracture line near the mid-point of the femur. The patient was discharged on May 21, 1940, with the clinical signs of union of the fracture of the right femur almost complete and with the patient himself in apparently good condition.

Case vi. Mr. T. G., age fifty-six, No. 69618, was admitted to Hahnemann Hospital complaining of pain in both feet. Examination of his feet revealed a dry gangrene of the right great toe and a swollen tender area on the medial side of his left heel. Both ankles were swollen. On May 14, 1941, neither tibial nor dorsalis pedis pulses were palpable. The patient gave a history of having had his feet frozen several times in the last ten years. During the past summer the patient apparently had symptoms of intermittent claudication. In November, the patient noticed that the right great toe was sore and this continued until April, 1941, when he injured this toe and it became infected. The toe was incised to establish drainage but the toe only became worse and turned black. He came to the accident ward seeking help and was admitted on May 14, 1941. The urinalysis, blood count, blood sugar and blood urea were all normal. Wassermann and Kahn tests were normal. Blood culture was sterile after 120 hours' incubation. Temperature was relatively normal except for a small rise in temperature to 99.0°F. each evening. Treatment was instituted as follows:

The legs were covered with a heat cradle and elevated on pillows. Dilaudid gr. 1/16 was necessary to control the pain; 150 cc. of 5 per cent saline were given daily for three days and then three times weekly. On May 16, 1941, the vacuum pressure boot was started on both legs. The saline and the boot seemed to aggravate the condition so that they were stopped on May 22, 1941, and the patient was advised amputation of the right leg above the knee because of the mortification setting in half way to the right knee. On May 25, under cyclopropane-oxygen anesthesia the right extremity was amputated just above the knee using the guillotine method. Good hemostasis was obtained, the flaps approximated and the incision closed with drainage.

Following this operation the patient was very much improved and had very little discomfort. The sutures and drains were removed May 31st and the patient was ordered out of bed. Dressings were changed daily.

On June 12th, the patient began to complain of the left heel which had apparently been healed. Whirl-pool bath was ordered daily. The patient then began having pain in the stump and the left heel and on June 15th a nerve block was ordered. Since the whirl-pool bath apparently aggravated this pain, it was discontinued.

On June 17th, a lumbar sympathetic nerve block was done; just before the block an abnormally high skin temperature was recorded. The patient was not relieved of pain and the temperature of the leg did not change. This was repeated on the 19th without relief to the patient. The patient complained almost constantly of pain in the left heel which had now become swollen and edematous. Pain continued until blood irradiation was performed on June 27th. Following this irradiation the swelling went down in the left foot and the area on the left heel began to heal and granulate. The stump of the right leg was almost completely healed following this and the drainage was negligible.

On July 3rd, the patient was discharged free of pain both in the right amputation stump and in the left heel, along with slight drainage from the left heel and the stump of the right leg.

THEORETICAL CONSIDERATIONS

In view of the fact that there seems to have been a definite connection between the use of ultraviolet blood irradiation therapy in the reappearance of the normal healing mechanism in these six consecutive cases of non-healing wounds, one must consider the possibility of supplying by ultraviolet blood irradiation therapy a missing non-specific factor to individuals suffering from similar non-healing wounds, such as may be encountered in war injuries.

It is our considered opinion that ultraviolet blood irradiation therapy may be of definite value in the treatment of non-healing wounds.

CONCLUSION

Further and extensive application of ultraviolet blood irradiation therapy in the treatment of non-healing wounds seems indicated.

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USE OF THE FOREIGN BODY LOCATOR (BERMAN) IN INDUSTRIAL PRACTICE

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IN many industrial and manufacturing processes and particularly where hardened steel parts such as chisels, punches, dies, etc., are struck with a hammer, it is not an uncommon occurrence for flying pieces of steel to embed themselves deeply within the tissues of workers.

Whether to attempt the removal of such a foreign body or to advise against it depends of course upon the doctor's appraisal of the situation. In most cases, however, it is advisable to remove a foreign body because of the ever present possibility of subsequent irritation and complications even if the foreign body remains fixed in the tissues, which it usually does. On the other hand, migrating foreign bodies are by no means a myth and such possibility must be reckoned with.

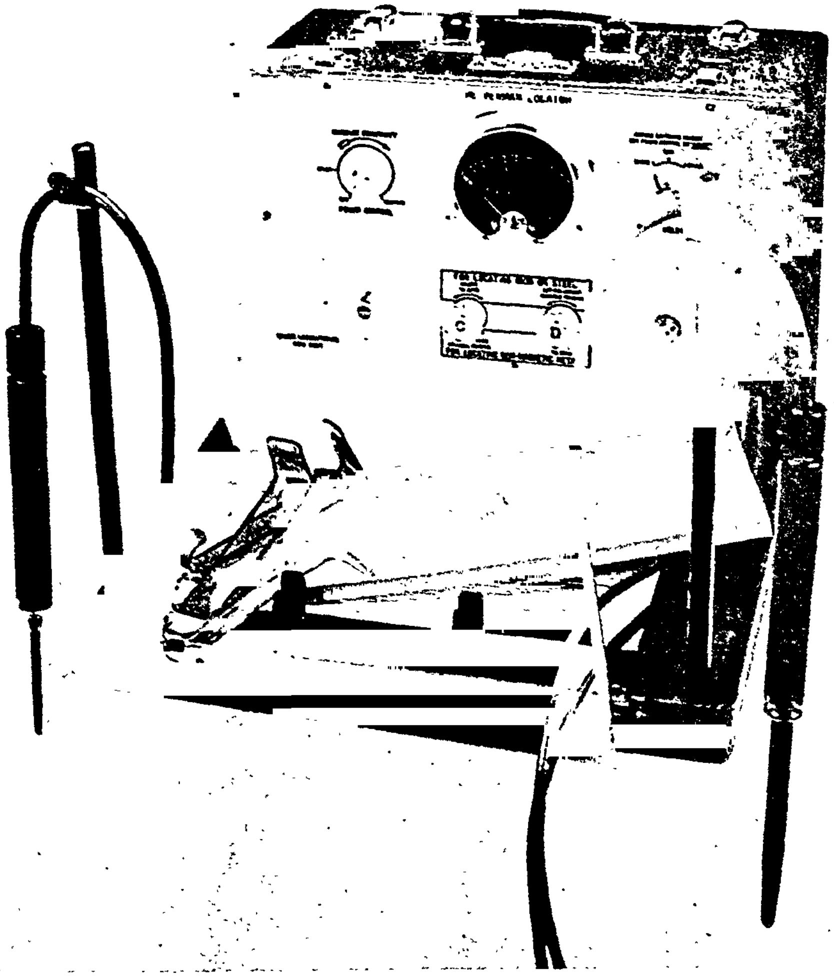
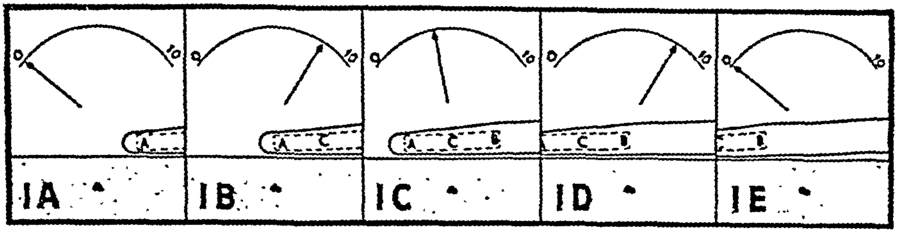
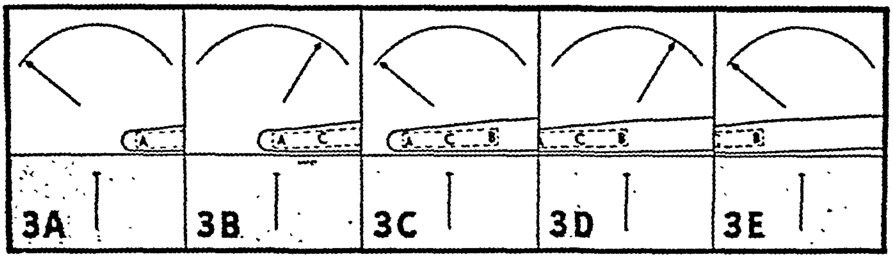


FIG. 1. Berman foreign body locator.

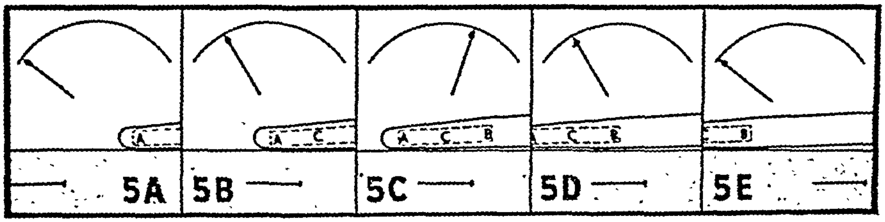
The truth of the matter is that immediate removal of a foreign body would nearly always be advised were such removal merely a routine surgical procedure involving no more than skill and conscientious effort on the part of the surgeon. Unfortunately, as all of us who have had any considerable experience with foreign bodies well known, such cases are far from being routine matters, are full of uncertainties and when attempted with only the customary *x*-ray localization, the search is often a prolonged, tedious matter and is apt to end in unexpected failure in a large percentage of cases despite the most accurate and painstaking work on the part of the radiologist. The difficulty of perfect interpretation of the *x*-ray plate for obtaining a correct surface localization, the possibility of a shifting of the foreign body with respect to the skeleton due to a slightly different position of the patient between the *x*-ray room and the operating room, the movement of the tissues by the surgeon's own manipulations during the operation and the hesitancy on the part of the careful surgeon to incise an important structure unless he knows beyond doubt that the fragment is actually there, all contribute to the uncertainty of the final outcome of such a case. At times, one will resort to the fluoroscope, but this procedure has many drawbacks, not the least of which is the danger of *x*-ray burns from repeated exposure of the hands to the rays.



When foreign body is globular, TWO high readings are observed; when either pole is over the particle.



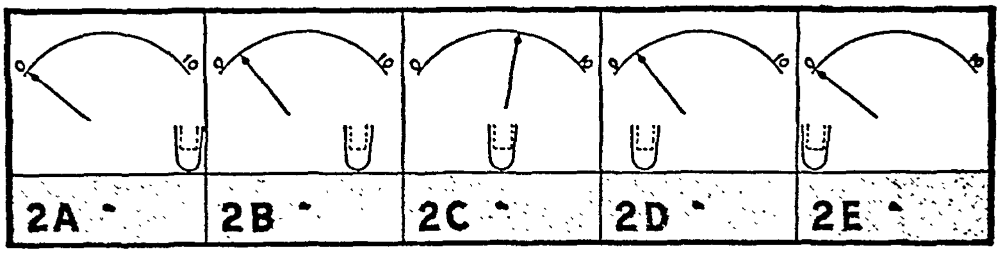
With needle-shaped foreign body, *vertical* to surface, TWO high readings are observed; these occur when either pole is directly over the needle.



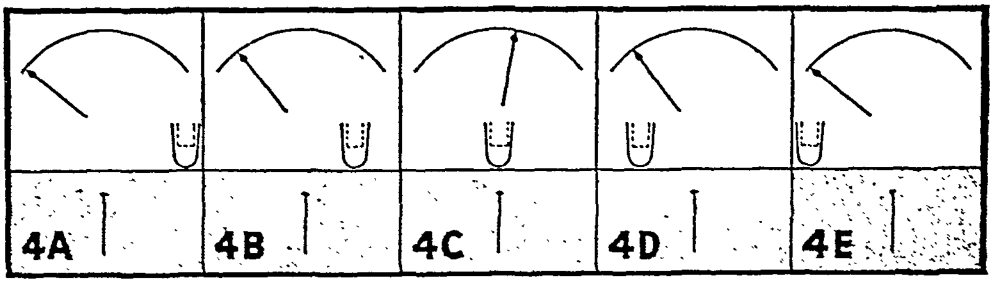
With needle-shaped foreign body, lying *horizontal* to surface, ONE maximum reading is observed when mid-length of probe inductance is over mid-length of needle.

FIG. 2. Various readings of different shapes of foreign bodies.

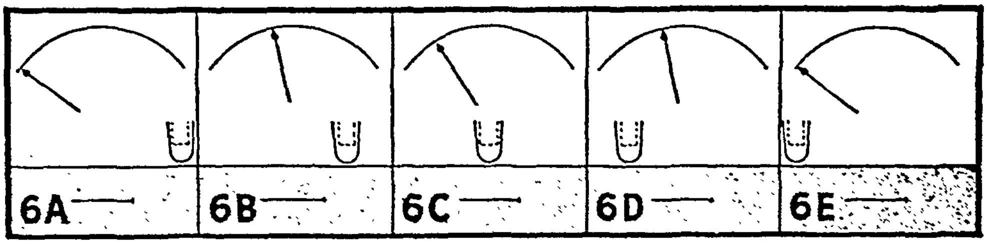
It was, therefore, with a great deal of interest that I read in the January 9, 1943, issue of the *Journal of the American Medical Association*, the paper by Dr. John J. Moorhead, of New York, describing the foreign body locator that was devised for him by Samuel Berman, then on the engineering staff of the New York City Transit System.



When checking with the probe held vertically to surface of the skin, the highest reading will be observed when probe tip is directly over particle.



When checking with probe vertical, ONE high reading occurs when probe tip is directly over needle.



When checking with probe vertical, TWO high readings are observed, each when probe is slightly beyond either end of needle.

Fig. 2. See legend on opposite page.

I was frankly skeptical about the possibilities of such a device until I received a case (Case IV) which was obviously difficult and delicate in nature. Upon my request, Dr. Moorhead removed this foreign body with the aid of the Locator. That demonstration was so impressive that I at once took steps to obtain such an instrument for use by the medical staff of our plant. I have now had the instrument for more than four months and, with its aid, have completed a sufficient number of foreign body cases to form some definite conclusions concerning its value.

The first outstanding fact is that I have not had a single failure since the acquisition of the Locator, in sharp contrast to a record of about 50 per cent failures previously. I can think of no more embarrassing situation for the physician than, after working on a patient for an hour or an hour and a half, to have to give up and announce to the patient that he could not find the foreign body. In a large plant where impressions of the medical facilities and personnel are widely circulated very rapidly, occurrences of such failures are definitely detrimental to medical-employe relation. The layman just cannot understand why a doctor should not easily find a foreign body when he has an *x*-ray which shows him "exactly" where it is.

The use of the Locator has changed the picture so completely that instead of viewing the prospect of a foreign body case with distaste and considerable misgiving, I now actually look forward to such cases with a certain degree of pleasure.

Contrary to expectations, I find the machine extremely easy to handle and operate and a very small amount of practice sufficed to acquire proficiency in its use. (Fig. 1.)

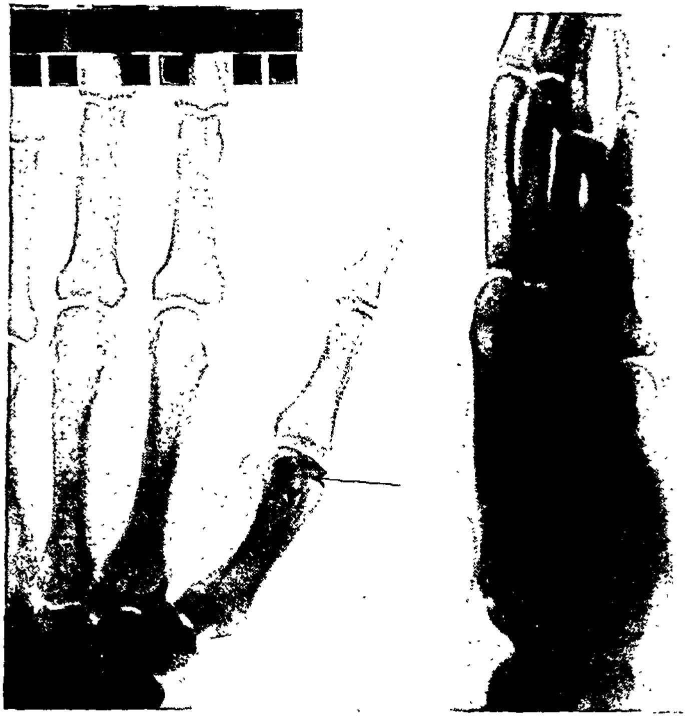


Fig. 3. Small foreign body over first metacarpal.

Briefly, the principle upon which the Locator operates is what is known as "electromagnetic induction." Detection takes place at some distance and contact with the foreign body is not at all required. The Locator does not possess any magnetic force for removing the foreign body. It merely detects its presence and accurately localizes it. It is most effective for iron and steel although it also has a slight sensitivity to other metals such as copper, aluminum, lead, etc. Its range of effectiveness is dependent upon the size of the fragment with a maximum of about four inches for the very large pieces and an average of about one inch for the average sized small foreign body of iron or steel encountered in industrial work. An iron pinhead (about 2 mm. in diameter) is detected from a distance of about one-half inch.

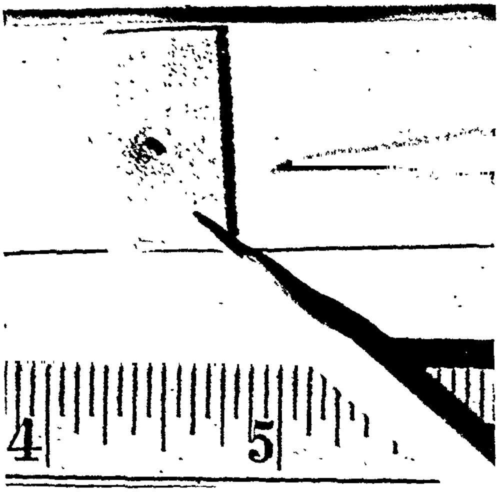


Fig. 4. Foreign body removed in Case 1.

The Locator has two probes (large and small) connected by flexible cables to the power unit. These probes are identical in action and differ only in size and sensitivity. The large probe is used mainly for preliminary surface localization and the small one is used for localization within the wound itself.

Localization is accomplished by moving the tip of the sensitive probe about the suspected area and observing the indication of the indicating meter on the panel of the power unit. The tip of the probe is closest to the foreign body where the highest reading is obtained.

The usual procedure is first to examine the patient with the large probe and determine the correct surface localization which is marked with some indelible marker. A depth estimate is then obtained by observing the meter reading at the marked spot and then selecting a sample piece of metal matching the foreign body as closely as possible in dimension and composition. The dimension of the matching sample is of course determined from the appearance of the foreign body on the x-ray plate. The matching sample is then brought close to the proble until the same reading is obtained as was previously noted over the surface localization on the patient's body. The distance at which this reading is obtained is a very close approximation of the subsurface depth of the foreign body. Then, while the patient is being prepared, a sterile rubber sheath is placed over the probe (usually the small one) and if the surgeon does not at once discover the foreign body, it is readily relocalized within the wound itself so that the surgeon may proceed in the correct direction. For best results, frequent alternation between the knife and the probe is advised. An important step in the procedure is to reinsert the probe within the wound after the foreign body has been removed, to check whether or not all of it has been removed. For this final check, the probe is used at maximum sensitivity. (Fig. 2.)

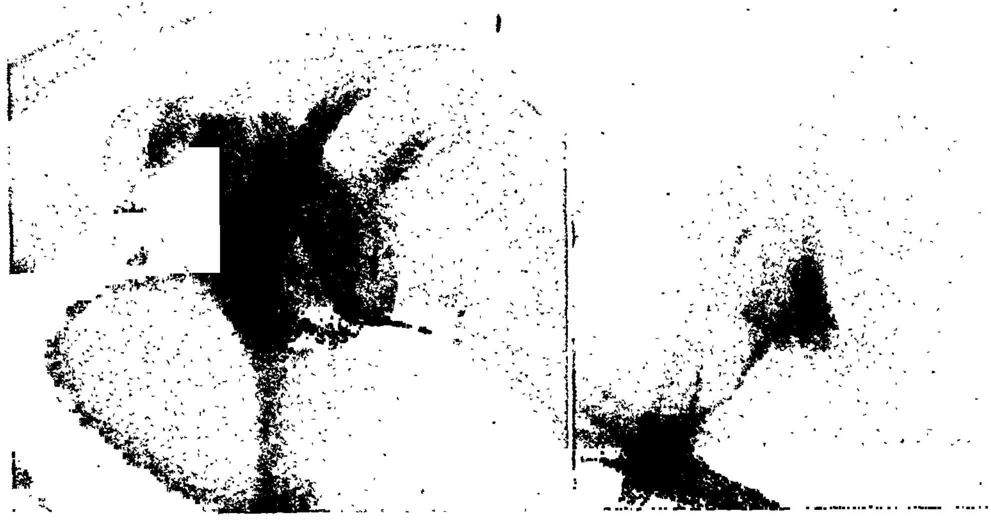


FIG. 5. A, foreign body in region of left shoulder; B, x-ray taken three months later shows no evidence of foreign body.

There are several points in the operation of the Locator that I wish to emphasize:

1. It is essential that a suitable person other than the operating surgeon be thoroughly trained in its use. Except in emergency, it is not practical to operate the machine and perform surgery at the same time. In our plant, one of nurses manipulates the machine while I perform the surgery.

2. Thorough familiarization with the operation of the machine and a reasonable time spent in practicing the finding of small bodies embedded in a suitable opaque medium (modelling clay has been found ideal) is necessary. The first successful case will more than repay one for the effort thus put in. The Locator is a remarkably sensitive instrument and its full possibilities should be capitalized upon.

3. It is important that a minimum of force be applied when using the probe

within the wound for two reasons: (1) The probe is sensitive to sidewise pressure and excessive force may deflect the internal sensitive element sufficiently to affect the meter reading; (2) some foreign bodies, especially needles, may be pushed deeper into the tissues by unnecessary pressure.

4. Good assistance is required in the surgical procedure. The high accuracy of the Locator ordinarily makes palpation unnecessary and superfluous, but requires good surgical technic with careful dissecting and hemostasis and everything being done to facilitate visual inspection. Since metal instruments cannot be left in the field when the probe is used, vessels must be tied off, instruments removed, and non-metallic retractors used. For small shallow incisions, sutures are best for retraction.

5. Very often the Locator will indicate a direction of the foreign body which the surgeon will hesitate to explore. Experience has shown the Locator to be invariably correct in its indications, and the surgeon is encouraged to follow its direction unless there are definite reasons to the contrary. Case 1 will illustrate this.

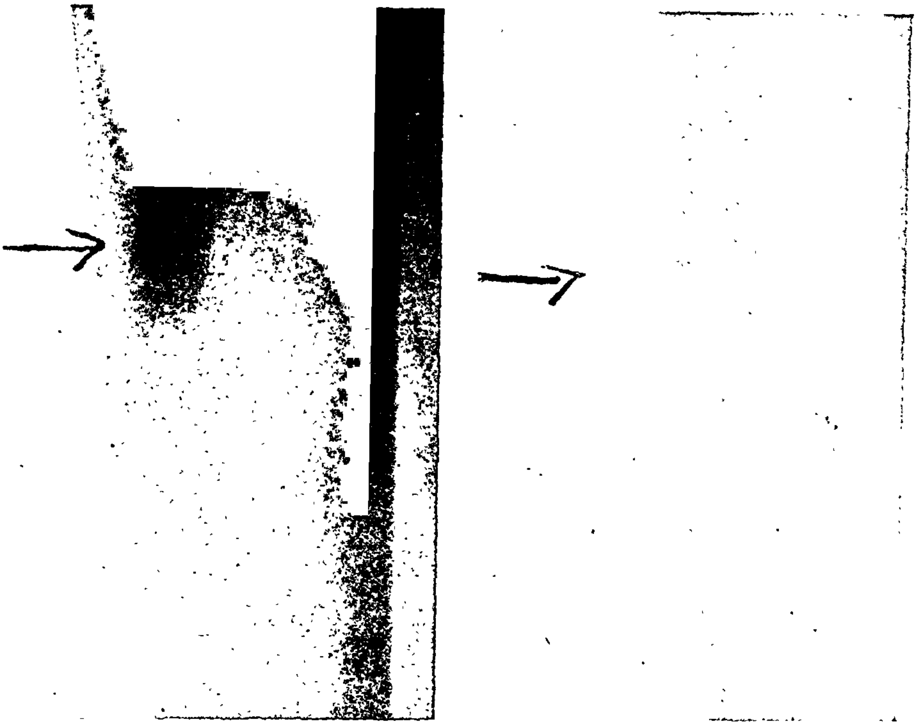


Fig. 6. Foreign body, mid-portion of right tibia.

The following are illustrations of some of the cases I have done:

Case 1. This man had a foreign body enter the region just proximal to the metacarpal phalangeal joint of the thumb. I accurately localized the fragment and proceeded with its removal. The Locator led me to a point just over the extensor tendon of the thumb, and yet I could see no sign of a foreign body. This being the first case in which I attempted to use the Locator on my own, I was afraid that I was misinterpreting its indications, and hesitated to incise the tendon. I closed the wound again, feeling rather disappointed. I promptly called Mr. Berman, the inventor of the device, who volunteered to come out and assist me with a second attempt. Mr. Berman's localization agreed exactly with my own and I went through the original incision until I reached the identical spot where I had stopped the previous time. The foreign body was directly beneath the tip of the probe although there was absolutely nothing to indicate that a foreign body had entered there.

Fig. 7. A, actual size of foreign body removed in Case v; B, same foreign body magnified ten times.

I opened the tendon and to my amazement found the foreign body directly within its substance. In my mind, I do not think this foreign body would ever have been found by any other method and this man would undoubtedly have had interference with the function of the thumb on account of this foreign body, had it not been removed. (Figs. 3 and 4.)

This illustrates two important things: First, that the prospective user must learn the correct use of the machine and practice sufficiently to have confidence in the correctness of his interpretations; secondly, that feeling certain of his interpretations, he may rely upon the indications of the Locator with complete confidence.

Case II. This case merely illustrates the fact that foreign bodies do move in tissues. *X*-ray picture on the left shows foreign body to be present in the left shoulder area. This *x*-ray was taken before I had the machine. Subsequent *x*-ray on right reveals no evidence of foreign body. Where the foreign body went, I had no idea. *X*-rays of the chest were taken and it still was not found. The danger of the foreign body's moving is greater, of course, in proportion to the small size of the object. The smaller the foreign body, the more apt it is to move. (Fig. 5.)

Case III. This case is interesting in that it remarkably demonstrated the value of this machine. The foreign body as can be seen in the *x*-rays, is rather a large one and made a wound of about ¾ inch long. Surface localization with the large probe over the wound of entry revealed no reading whatsoever. The probe was passed over the surface of the leg and a maximum reading was obtained three inches below the site of the wound. An incision was made over the area where the locator gave a maximum reading and the foreign body was found without any difficulty. (Fig. 6.)

Case IV. This man had a piece of steel in the substance of the thyroid gland. With the aid of the Locator throughout, a 1½ inch incision a piece of steel about ⅜ inch long and ⅛ inch thick was removed. This was done by Dr. Moorhead, at the Post-Graduate Hospital before I obtained the machine. The operation was done with a minimum amount of trauma and disturbance to the thyroid and was an impressive demonstration of the value of the Locator.

Case V. This case illustrates the extreme sensitivity of the machine in that it enabled us to extract a sliver of steel, the thickness of a hair and ¼ inch long, from the tissues. Figure 7 is a reproduction of the steel removed. The sliver is almost too fine to be visualized by *x*-ray and I was not sure whether there was anything in the tissues or not. Surface localization with the large probe gave a reading indicating the presence of a foreign body. I made an incision and extracted the small piece on the right. To be sure that all the steel had been removed, I tested the area with the locator and again obtained a reading. I explored the wound further and extracted the piece on the left. I had not realized up to this time that such a small particle of steel would be recorded on the machine. This demonstrates the fine use that can be made of this apparatus. (Fig. 7.)

Since this time, we have utilized the machine in daily practice on patients who come in stating that they think they may have a steel splinter in their hands or fingers. Surface localization is attempted, and if there is a splinter present, no matter how small, it will give a reading. This saves the patient unnecessary probing and trauma to the tissues in attempting to remove splinters that are present.

Other cases completed with the aid of the Locator were routine in character and presented nothing unusual except that the foreign bodies were all quickly found without any difficulty. No purpose would be accomplished by reporting these in detail except to again illustrate the value of the Locator in this work.

SUMMARY

1. The use of the foreign body Locator in industrial practice is discussed with its applications.
2. Practical points in its use are mentioned.
3. Various, typical cases are illustrated.

CONCLUSION

I consider the Berman Foreign Body Locator indispensable in the treatment of foreign bodies. It has a wide application in industrial practice.

* * *

MUCH of the most important of vulvar tumors is carcinoma, which is the third most common of all gynecological cancers, being exceeded in frequency only by cancer of the uterus (cervix and corpus) and cancer of the ovary.

TREATMENT OF INFLAMMATORY URETHRAL STRICTURES

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THE treatment of urethral strictures is probably less well understood and treated with more ill advised confidence than any other serious body lesion. That strictures may produce urinary back pressure is presumably universally acknowledged, but it is the urologist that appreciates the actual ravages of a stricture for it is he who finally inherits the patient with his bladder and kidneys hopelessly exhausted. It is the purpose of this paper to outline a rapid and safe method for the non-operative treatment of small caliber inflammatory strictures. I mention urethral inflammatory strictures specifically since neglected traumatic strictures usually demand surgery and belong only in the hands of a competent urologic surgeon.

A urethral stricture of 22 F. caliber presents no profound therapeutic problem. This stricture is of moderate proportions and dilatations are undertaken at five-day intervals with metal sounds until the urethral caliber is normal and then gradually the dilatation interval is increased. However, instances in which the urethral caliber is no greater than filiform size constitutes the problem that is so often mishandled.

The introduction of the filiform through a stricture is accomplished by patience. Sometimes the use of a urethral blunt-nosed syringe filled with mineral oil is effective. The penis is held at the coronal sulcus between the first and second fingers of the left hand and the mineral oil is injected slowly into the urethra. When its passage meets with obstruction gentle pressure is maintained until some of the oil slowly passes through the stricture. The urethral meatus is then compressed between the first and second fingers of the left hand and a filiform is gently introduced into the urethra until the obstruction is encountered. The filiform is repeatedly withdrawn slightly, twisted and re-introduced until the stricture is traversed. Gentleness is the secret of success in the introduction of a filiform and any other approach is rewarded with only trouble and tragedy. It is not unusual to spend fifteen to forty-five minutes or even longer in introducing a filiform through a stricture of small caliber. The use of oil will permit the passage of a filiform when other methods fail since the oil distends the stricture and thus straightens and lubricates the course of the stricture which is characteristically serpentine in contour. However, it is to be remembered that the introduction of oil plus rough handling may produce an oil embolus.

After the filiform has successfully traversed the stricture it is imperative that the filiform is not withdrawn, but that a Phillips catheter follower be attached and introduced into the bladder. The largest Phillips follower is attached that can be introduced into the bladder without marked discomfort to the patient. The Phillips catheter is strapped in position so that the vesical urine drainage is free and the attached filiform lies curled in the bladder. The patient is confined to bed. If the vesical retention is massive and chronic, gradual decompression is desirable. Fluids are forced and some urinary antiseptic administered. Urotropin is a particularly satisfactory urinary antiseptic for this purpose since there are no factors of toxicity or sensitivity to be considered. The maximum effectiveness is dependent upon a urine with a hydrogen ion concentration of *5* or less; hence, fruit juices are absolutely forbidden since they produce an alkaline ash. For short periods the usual sodium acid phosphate salt is effective in reducing the urine hydrogen ion concentration to the desired level. Furthermore, during the period of the inlying urethral catheters, it is essential that the bladder be thoroughly irrigated twice daily with at least 1,000 cc. of solution at each irrigation and the urethra must be thoroughly but gently flushed at each change of catheter. A *5* per cent lactic acid solution makes a very satisfactory solution for irrigation.

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In hospitals where urologic surgery is not commonly done an apparatus for gradual vesical decompression is usually not available. This problem can be solved by inserting into the end of the bedside bottle tubing a Luer needle of 20 or 22 caliber and thus vesical emptying progresses slowly. The sterility of the bedside tube and bottle is essential and should be re-sterilized at intervals of twenty-four hours. The connection of the rubber tube and the Phillips catheter follower is most successfully accomplished by slipping the rubber tube over the expanded end of the Phillips follower rather than to attempt a union with a glass connector.

After the filiform and follower have been in position for twelve hours or at the most twenty-four hours, the penile strapping is removed and the follower pulled out of the urethra to the screw junction and a follower of two French sizes larger screwed in position, inserted into the bladder and restrapped. It is important that the filiform be not removed from the bladder and only brought out to the meatus so that a larger follower catheter can be attached. The follower that has been retained for twenty-four hours is discarded since the urethral secretions and urine will have usually caused surface deterioration.

When larger urethral Phillips follower catheters are introduced it will be quite universally observed that the follower which is 2 F. sizes larger than the one removed will slip easily in position and on no occasion should a follower be used that binds at the stricture site. It will be the usual experience that increasingly larger followers can be introduced at twelve-hour intervals so that in a period of two days the urethral caliber can be increased from 12 to 18 F. or in three days to 22 F. This affords a remarkable amount of safe dilatation in a comparatively short time.

After the urethral stricture has been dilated with Phillips filiform and followers to 22 F. the follower with its filiform is removed and the urethra painstakingly washed out being particularly careful not to overdistend the urethra and thus spread the bacteria laden products of catheter irritation into the contiguous ducts and glands of the urethral mucous membrane. When the urethral irrigation fluid returns clear, a bevel edge soft rubber catheter of 20 F. size is introduced into the bladder, adjusted for free flow and strapped in position. A Foley retention catheter may be substituted for the bevel edge catheter since it has the added advantage of not requiring penile strapping. The same plan of increasing the size of the rubber catheter is followed as was done with the Phillips filiform and followers; that is, a rubber catheter of 2 F. sizes larger is introduced after each twelve-hour interval of urethral retention until a 26 F. catheter has been maintained in position for twelve hours.

It is wise to confine the patient for at least twelve hours following the removal of the last dilating catheter. The reason for this practice being that after the catheter is removed the urinary tract is transposed from an open to a closed system (its normal state) and this transition may be, on occasion, followed by a bout of fever, muscle pain and malaise. If this complication occurs, it is treated by introducing a urethral catheter, washing out the bladder, forcing fluids or administering intravenous fluids. The intravenous fluid of choice is 5 per cent glucose in distilled water (instead of saline) so as not to place an additional burden of salt excretion on kidneys that may already have a minimum of reserve. With the above therapy the pyrexia usually subsides rapidly. On the other hand, if the symptoms continue or there is a reappearance of fever it is wise to seek the aid of a urologist for additional investigations of the patient's urinary tract.

When the final dilating catheter is removed it is a good practice to fill the bladder previously so that the patient may immediately void, upon withdrawal of the catheter. This is important particularly for psychological reasons, since it is not hard to see that a patient who has been straining to void a needle-size stream is considerably encouraged and pleased suddenly to experience an effortless normal urinary stream.

Resume. The following points constitute the routine in this method for dilatation of small inflammatory urethral strictures:

1. A urethral filiform is passed through the urethral stricture.
2. A Phillips follower catheter is attached to the filiform and inserted into the bladder for drainage and dilatation. If the stricture will not permit a Phillips catheter to pass, the filiform is fixed in position for twenty-four hours after which time a small Phillips catheter will usually traverse the stricture.
3. The bladder is to be decompressed slowly in the event of chronic massive retention. A simple method is outlined in the substance of the paper.
4. A urinary antiseptic should be administered during the course of dilatation.
5. The bladder should be washed with 1,000 cc. of some irrigating fluid twice daily and the urethra washed clean at each change of catheters.
6. The dilating catheter followers are increased 2 F. sizes every twelve hours until a Phillips catheter of 22 F. is reached.
7. After a 22 F. catheter follower is retained for twelve hours the follower and filiform is replaced with a 20 F. soft rubber bevel edge catheter.
8. The caliber of the rubber urethral catheter is increased 2 F. sizes every twelve hours until a 26 F. catheter has been maintained in the strictured area for twelve hours.
9. The patient is then treated with urethral dilatations by metal sounds at intervals of two days at first and the interval is gradually increased as it is noted that there is no intervening diminution in the caliber of the urethra at the original stricture site.

In conclusion, it is to be emphasized that a malignancy of the urethra must be suspected in any stricture, irrespective of its apparent etiology, which does not respond to dilatation and particularly if repeated dilatations are accompanied with profuse urethral bleeding. Such an individual is entitled to a careful diagnostic study by a competent urologist.

SUMMARY

A rapid, safe and long tried non-surgical method for treating small caliber inflammatory urethral strictures is presented for the benefit of the general practitioner and those not especially trained in the treatment of urological conditions.

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PILONIDAL SINUSES AND CYSTS*

A RECOMMENDED METHOD OF TREATMENT

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AND
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PILONIDAL sinuses of the coccyx are being encountered with surprising frequency among the fighting forces. It is the men in combat areas who are missed most as a result of this disabling condition. The comparative effect is even greater when one stops to realize that members of the Mongolian race have always been considered to be free from this disease. Negroes rarely are so affected, and the American Indian exhibits the condition rarely or not at all.

The incidence of this disease in the armed forces of the United States, although impossible to determine accurately at this time, is certainly high, chiefly because one deals with males who fall into that age group in which such occurrences are noted most frequently. The number of man-days lost while on the sick list for this condition varies from about seventy to as many as 200+ days, with an average of about three months. Were it possible to combine the figure for true incidence with this period of disability an astounding figure for "fighting days" lost would be revealed. DePrizio[1] has estimated the incidence at one station hospital to be 1 per cent of the total personnel.

The recurrence rate is also very high. The method of treatment seems to influence this rate so that the exact recurrence is difficult to determine, but it is variously given as from 19 per cent (the lowest record found excepting one report of no recurrences) to 33 per cent in selected cases with primary closure.

DEFINITION

Before dealing with the recommended methods of treatment, it is necessary to deal briefly with the definition and theories of these teratomatous cysts. Of the many terms which have been applied, "pilonidal cyst" is the most common. Late studies as to the origin have introduced terms which are based, more or less, on embryological development. By definition, these are epithelial-lined cysts (often merely sinuses) of congenital origin occurring in the skin overlying the sacrococcygeal region, superficial to the bone, and in, or adjacent to, the midline. It is this definition upon which the recommended method of treatment has been based.

The symptoms, signs, diagnosis, and differential diagnosis will not be discussed here since articles may be found in any standard work dealing with the subject.

ETIOLOGY

From a study of the available literature it appears that the condition was first described by Warren[2] in 1867. No mention was made at that time of its origin. Scientific curiosity as to its origin was aroused slowly, and it was not until about 1882 that Lannelongue[3] advanced the theory that it was a process of ectodermal invagination due to faulty skin agglutination of the sacrococcygeal region. In 1887, Tourneux and Herrman[4] advanced the theory that these cysts originated from a persistence of coccygeal vestiges of the neural canal. These two theories have evoked considerable controversy. Mallory,[5] in 1892, strongly supported the neural canal origin. Further impetus was given to the support of this theory by Moise,[6] in 1926, and by Ripley and Thompson,[7] in 1928, when they described cases in which a connection existed with the neural canal and was the source of meningitis. In 1934, Stone[8] advanced his idea that these pilonidal cysts arose from a vestigial structure analogous to the Preen's gland of birds. There has been a general lack of support of this belief. In 1935, Fox,[9] following studies of the human embryo, gave support to the invagination theory. He concluded that this invagination occurred during the third and fourth months of embryonic life from cells destined to form appendages as hair and glands.

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* The opinions and/or assertions contained herein are the private ones of the writers, and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

After a review of the available data on the embryological development of structures in this area, the authors believe that the persistence of the neural canal remnants accounts for the condition only in those rare instances in which a sinus tract is found extending beneath the sacrum and coccyx, and that the majority occur merely as a result of the invagination of ectoderm.

It is not believed that trauma produces the condition, but only accentuates it by causing: (1) infection, (2) the stimulus for increase of secretion from the enclosed sebaceous and sweat glands in an area prolific with hair follicles, sebaceous and sweat glands, and (3) blockage of the original sinus tract communicating with the outside from resulting edema and excoriation of the epithelium, and, perhaps, by actual occlusion of the sinus by direct union of the edges. Credence is given this view from the fact that these cysts contain grumous, buttery material, and that on microscopic examination they are found to be lined with ectoderm, but without any mixed elements in the surrounding tissues. Almost invariably infection is present and often pus obscures the remaining contents. In addition, it is believed that these cysts are at first rather small or exist only as sinus tracts, and become large or even huge in size as a result of filling and stretching, with small ruptures into neighboring normal tissue, followed by burrowing sinuses which later become epithelialized from the parent cyst and persist as daughter cysts.

RECENT TRENDS IN TREATMENT

Without fail all articles reviewed stress three basic principles as regards treatment: (1) Treatment of the infection before surgery is performed; (2) the successful removal or eradication of the cyst and all its tracts; and (3) subsequent healing of the wound. It has been a universal axiom that in all cases in which the cyst is infected drainage should be established and measures employed to combat the infection for some ten days to two weeks before any operative procedure is carried out.

There is complete agreement as to the absolute necessity of observing the first and second of these principles, and the different forms of treatment have evolved in an attempt to increase the speed and effectiveness with which the third principle could be accomplished. It is largely with the first and second principles that the proposed method of treatment takes variance. It has also resulted in a distinct lessening of the time required in attaining the desired third principle.

A few of the recent methods of treatment will be mentioned briefly. Further details may be obtained by consulting the references. Colp[10] advocated primary closure wherever possible, depending upon the amount of previous infection, proximity to the rectum, and the ability to obliterate dead space. Tendler[11] performed primary closure in approximately 20 per cent of a series of eighty-seven cases, of which one-third broke down or became deeply infected. Camp and Polites[12] reported excellent results with primary closure in twenty-two cases with no recurrence, and essentially primary healing in fifteen other patients still in the hospital. The total hospitalization for these cases, however, averaged forty-five days, due in part to the time required for preoperative conditioning of the patient. Their "no closure" cases average seventy-four days for eight cases, and the "partial closure" cases averaged ninety-three days for four cases. No other series has been found in which such excellent results with primary closure are reported.

Several methods have been advocated for partial closure of the wound in an effort to speed recovery. DePrizio[1] removed the sinus by undercutting the skin edges, removing the sinus and excess fat, and then suturing the skin flap down into the wound. In his cases, closures were affected in slightly less than five weeks. Brezin[13] described a method of reflecting a pedicle skin graft from above the sinus and using that flap to close the defect completely or partially. He reported that healing occurred in twenty-six days by this method. In this category also falls the standard and well known "Lahey flap" method.

The number of authors advocating complete removal and no closure constitutes by far the majority. Most surgeons prefer to accomplish the removal of the tract and sinuses by sharp dissection with the knife or with the electrosurgical unit. On the other hand, there have been some reports of good results accomplished by destroying the sinus wall and sinuses with a sclerosing solution. Among the outstanding champions of this method have been Cutler and Zollinger,[14] and Block and Green,[15] who reported favorable results with Carnoy's solution or modifications of it. Swinton and Hodge[16] went further by excising in a block dissection and using modified Carnoy's solution dressings for a short while.

The main factors which caused a search for a new form of treatment were: (1) that no operation had been found which was satisfactory in preventing recurrences or avoiding a long period of hospitalization in the majority of the cases; and (2) a study of the origin of these sinuses resulted in the opinion that the ectodermal lining could be utilized in covering the defect and permitting free drainage of the products of the sweat and sebaceous glands contained therein. The procedure to be outlined can be carried out in the presence of infection. This eliminates the long preoperative stay on the sick list. The procedure is very simple and can be done aboard any ship, whether it be a destroyer or a larger vessel, with only a few days lost from work.

PRESENT PROCEDURE

Since a thorough review of the literature cannot be carried out at this time, no claim of originality is made for this procedure. In a discussion of this method, one surgeon remarked to the authors that the same or a similar procedure had been carried out at the Mayo Clinic. The authors regret deeply that they are unable to locate this or possibly other articles in order to give proper credit where it belongs.

The patient may be operated upon in the presence of marked infection so that no extended preoperative preparation is necessary. The usual field preparation is done and the patient is given morphine sulfate, ¼ with atropine sulfate, gr. 1/150 about forty-five to 60 minutes before surgery is to be performed. At the time of operation, Bearse straps of adhesive tape are applied to pull the buttocks apart and the anus is protected with gauze or cotton. The routine skin preparation is carried out. Procaine solution, 1 or 2 per cent, is injected into the skin and subcutaneous tissues about, but clear of, the area of redness, and extending down deeply enough to block the field. After about five minutes an incision is made in the midline over the most prominent part of the cyst. When the cyst is entered, pus or grumous material will exude, depending upon the amount of infection and collected débris. When this material has been removed from the cyst, the incision is extended the full length of the cyst (Fig. 1) and any sinus tracts are opened to the surface in the same manner. If there are over-hanging edges, these are trimmed away. (Fig. 2.) The entire cyst and tracts are wiped out well with dry gauze. A small curette or a large rounded knife blade is used to curette away the dead, superficial layer of the cyst wall. This having been accomplished, *a thorough inspection is made for other* sinuses which may have been missed previously, and, if found, they are opened in a similar manner and curetted. After all visible tracts have been opened and curetted, a wedge-shaped piece of tissue is removed from between the cyst wall and the cut skin edges (Fig. 3) all around so that the skin edges and the cyst wall will approximate without any tension. (Fig. 4.) The wedge is carried only as deep as is necessary for the purpose. Fine Babcock stainless steel wire on a half-circle cutting needle is preferable as it is non-capillary, although silk, linen, cotton, and dermal sutures could be used. Closure of the skin to the cyst wall is accomplished with a continuous suture. A small amount of vaseline gauze covered by dry dressings is applied and held in place with a "T" binder. The patient is usually allowed to walk back to his bunk.

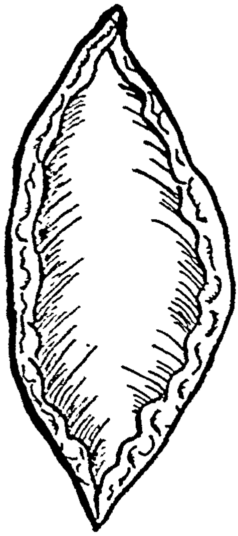
FIG. 1. Longitudinal section showing cyst open.

Morphine is given to relieve pain during the first twenty-four hours but more than two doses are seldom needed. Beginning on the first postoperative day (but not on the day of operation) the patient is started on a course of hot sitz baths, given thrice daily, followed by the original type of dressing. This program is continued for one week and then only twice daily thereafter. The sutures are removed seventy-two hours after the operation when wire is used as it tends to become imbedded and the skin heals over it, making its removal difficult at times. Other types of sutures may be left in longer, but as there is very little tension on these it is seldom necessary. As soon as the sutures are removed the patients are allowed to return to duty and are instructed to return to the sick bay for the hot sitz baths and dressings.

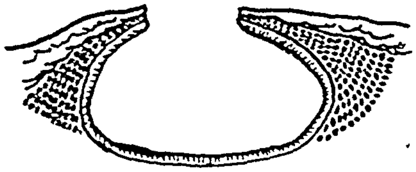
FIG. 2.

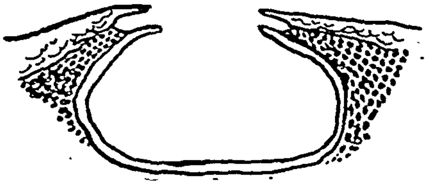
FIG. 3.

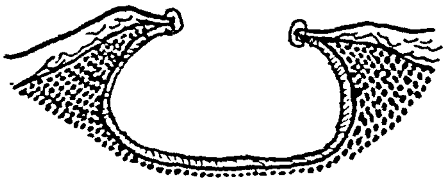
FIG. 4.

FIG. 2. Cross section showing overhanging edges cut away.
FIG. 3. Cross section after wedge has been removed between skin and cyst wall.
FIG. 4. Cross section showing skin edge united to cyst wall.

RESULTS

The senior author has used this method for three years. The earlier patients who were operated upon aboard one of our hospital ships were given cards to be returned in case of recurrence. Thus far, no cards have been received, nor did any patient return to the hospital ship with recurrence. Three patients operated upon by this method when it was first employed have been interviewed recently and are in excellent condition and have not had any further trouble. All patients operated upon similarly during the past year are still under observation and appear to be completely cured. Due to war conditions the special case records kept on these cases are not available for individual tabulation, except for those patients who were operated upon during the past year. Therefore, the exact number of cases in which this procedure has been done cannot be stated but it is estimated conservatively at between seventy-five and one hundred. The average time for patients to remain on the hospital ship was between three and four weeks. This period of hospitalization was only in keeping with the policy of obtaining complete healing, or practically so, before returning the patients to duty. Even so, after three days all were placed on working details. This has been the practice also with the more recent cases. There have been no cases of spreading infection and bleeding has been minimal, seldom necessitating the use of ligatures.

Fig. 5. Case i. Scar eleven months old; complete healing eighteen days after operation; sick five days.

Fig. 6. Case v. Scar five weeks old; complete healing fifteen days after operation; sick three days.

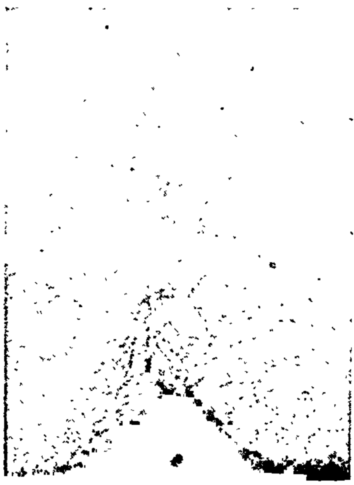

Fig. 7. Case vi. Scar five weeks old; complete healing fifteen days after operation; sick three days.

Fig. 8. Case vii. Scar ten days old; not completely healed at top and lower left; sick three days.

In civilian practice most patients could return to work after three or four days as they are allowed to do when operated aboard ship. It will be found that during the healing stage pain is extremely rare.

COMMENTS

As previously mentioned, this method is directly opposed to the staunchly supported principles in the treatment of this condition; these are complete removal of the sinus and tracts, and the eradication of infection and the establishment of drainage, if necessary, before operation was done. The latter practices usually required about two weeks of preliminary care, since the cyst cannot be opened and the patient be permitted to return to duty and be advised to return for operation later, since a flare-up is the rule during the preoperative interval. The procedure employed by the authors certainly accomplishes adequate drainage and instead of attempting to remove the wall of the sinus and tracts, it is utilized to re-epithelialize the defect. Granulations are relatively few; the scar is much smaller than the original defect, and the new skin appears tougher than an ordinary scar.

Invariably the question is asked, "What about other sinus tracts which may be missed?" There are two possible reasons why such sinuses apparently cause no trouble: first, most patients are operated upon when the cyst is well distended or soon thereafter, so that probably all sinuses are opened enough to be visualized at the time of the operation; and second, by permitting these sinuses to have an undisturbed opening onto the surface they have free drainage, and thus will cause no trouble. This belief is predicated on the fact that drainage of the parent cyst is always followed by relief from symptoms and infection, showing that the tracts, when allowed free drainage, are symptomless and are usually free of acute infection. Removal by sclerosing methods or by dissecting across the tracts may result in healing over and sealing of the tracts, thus allowing a repetition of the original process. In other words, it is believed that by replacing this tissue on the outside of the body where it belongs it will behave in a normal way. Time alone will tell if this assumption is correct.

Another question frequently asked is, "What about those sinuses which extend beneath the sacrum and coccyx?" Thus far the opportunity has not been afforded to treat one of these by this method. These are occasional cases in which the sinus possibly arises from remnants of the neural canal. It is believed that by removing the coccyx and opening this tract up as far as possible or throughout its entirety that the results would be equally satisfactory since free drainage would then be afforded.

SUMMARY

1. The incidence of pilonidal sinus is three times more common in males than in females of the age group of greatest usefulness for military service. The incidence in military and naval personnel is high. It is rare in the negro and among American Indians and has not been described in the Mongolian race. The number of man-days lost at present is of tremendous import to the service.

2. These structures are best defined as epithelial-lined sinuses of congenital origin, occurring over the sacrococcygeal region, superficial to the bone, and in, or adjacent to, the midline.

3. Three theories of origin are discussed. They are: (1) invagination of the surface epithelium, (2) remnants of the obliterated neural canal, and (3) an analogue of Preen's glands in birds.

4. The general trends in treatment as usually practiced are based on: (1) complete removal or eradication of the sinus and tracts, (2) healing of the wound, and (3) preoperative care and treatment of the infection. Various types of procedures to accomplish these results are discussed briefly.

5. The reasons for developing a new type of treatment were: (1) none of the

operations in common use satisfactorily prevents recurrences or long hospitalization in the majority of cases; and (2) the nature of the origin of the sinus provided a clue as to a simpler and more certain method of treatment. The operation can be carried out without a long preoperative stay on the sick list. It is simple and can be carried out aboard any ship, of destroyer size or larger, with only about three days lost from duty.

6. The method described consists in thorough opening of cyst and tracts with marsupialization of the cyst wall to fill the defect. It can be carried out in the presence of heavy infection. Bleeding is minimal, no spread of infection occurs and healing is rapid and relatively painless.

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THE USE OF TYROTHRICIN IN THE TREATMENT OF ULCERS OF THE SKIN

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AN excellent contribution to the list of substances possessing antibacterial action was made by Dubos in 1939 when he first isolated an extract from Bacillus brevis, a gram-positive aerobic spore forming soil bacterium. This extract, consisting of at least two substances, gramicidin and tyrocidin, was the result of two years of study and is known as Tyrothricin.

Since 1939 various articles have appeared in the literature on the experimental work, the chemical properties, the toxicity, the hemolytic effect, and methods of use. It seems that the consensus of opinion is that Tyrothricin is ineffective when administered orally, that it exerts no effect unless it can come in direct contact with the organisms, is ineffective and very dangerous when given intravenously, and that it should be administered only locally. Because of this, its field of usefulness so far is very limited. Reports show it to be of value in the treatment of mastoiditis, empyema, suppurating arthritis and deep wound infections. Charles H. Rammelkamp, in 1942, reported upon twelve patients with localized ulcers treated with Tyrothricin with good results in nine cases. While all the cases in the literature speak of the action of Tyrothricin on the bacteria in the ulcer, no mention has been made of one property that I noticed in five of the six patients treated, namely, tissue stimulation. I have treated six patients with very bad ulcers of the lower leg using Tyrothricin with excellent results in five of the six cases.

CASE REPORTS

CASE I. A female child, J. M., age five, white, was admitted to the Delaware County Hospital on December 17, 1943, with a large ulcer of foot following trauma. There was very little improvement from usual applications and from rest in bed. On January 10, 1944, Tyrothricin was started locally. The treatment consisted of compresses of gauze kept moist with Tyrothricin using 0.25 cc. of Tyrothricin to 99.75 cc. of sterile distilled water. On January 22, 1944, twelve days later, the ulcer was entirely healed and the patient was discharged.

CASE II. A male child, J. W., age four, white, was admitted to Delaware County Hospital on July 11, 1943, with extensive third degree burns of the right leg. The burn was treated with tannic acid and after the eschar was removed, there was a large amount of pus present and very little granulation tissue. Various applications of saline were used with only slight improvement. On September 17, 1943, Tyrothricin was started using the same treatment as in Case I. Granulations rapidly developed and on October 7, 1943, a skin graft was done. On October 23, 1943, the patient was discharged with the burned area entirely healed.

CASE III. A white girl, D. G., age fifteen, was admitted to Delaware County Hospital on August 30, 1943, with an old, unhealed area, the result of a burn two years before. The same method of treatment with Tyrothricin was carried out, but by September 23, 1943, there was no apparent improvement in the ulcer so the patient was discharged. The Wassermann test was negative.

CASE IV. A white man, D. B., age thirty-seven, had had an ulcer of the lower left leg for fifteen months. He was a druggist and so had access to all kinds of salves, ointments and various drugs. He had been to several physicians who had injected his veins on several occasions but without any apparent improvement. The ulcer, 1¼ inches in diameter, was causing a lot of pain and discomfort and interfered with his work. His Wassermann test was negative. He was instructed in the method of treatment and on December 6, 1943, treatment as in Case I was started. Three weeks later there was marked improvement and on January 17, 1944, the ulcer was healed and the patient was discharged. Two months later the ulcer was still healed.

Case v. A white woman, R. W., age forty-nine, was seen in my office on November 4, 1943, suffering with a large ulcer with necrotic edges and 2 inches in diameter, on the medial side of the left lower leg. This ulcer had been present for ten months and she had been treated by several physicians using various forms of ointments, powders and dressings. She had also been in a good hospital for three weeks with absolute rest in bed. She had had various injections in her veins, but in spite of the treatment the ulcer had progressed. She was complaining of severe pain in her leg and was unable to do her housework, being able to be on her feet only a short time during the day. She was admitted to the Delaware County Hospital on November 11, 1943, and treatment, as outlined in Case I was carried out. Her Wassermann test was negative. On December 1st, she was allowed out of bed and was discharged healed on December 4, 1943. On April 1, 1944, the patient was in excellent condition, the ulcer was still healed, she was not suffering any pain, and was able to do all of her work.

Case vi. A white woman, M. B., age sixty-four, was admitted to the Delaware County Hospital on December 17, 1943, with a very interesting history. Her home was in Washington, D. C., where in March she suffered a slight injury to her left lower leg. Although she was treated by an excellent surgeon, the wound would not heal. She was then treated by a dermatologist and the ulcer progressed. In September, she was brought to Philadelphia by her sister and put under direct supervision and treatment of one of Philadelphia's ablest dermatologists. Her Wassermann test was negative. By December, the dermatologist was discouraged and told me that the ulcer was progressing in spite of everything he could do and asked for suggestions. I immediately suggested hospitalization and treatment with Tyrothricin. Reservation for admission on December 19, 1943, was made, but on December 17, 1943, she suffered a left-sided hemiplegia and was admitted on December 17, 1943, to the Delaware County Hospital. Since the onset in March she had been treated with various antiseptics, ointments, powders, hot wet compresses, ultraviolet light, x-rays, injections in her veins and rest in bed. At the time of admission the ulcer was 2 inches in diameter with three or four other small beginning ulcers. Treatment with Tyrothricin as in Case I was started on December 19, 1943. Her paralysis showed gradual improvement. After two weeks there was a marked improvement in the pain in the leg, the discharge was much less and the ulcer looked healthy. On January 23, 1944, she was discharged from the hospital with the small ulcers healed and the large ulcer about one-third its original size. Treatment with Tyrothricin was continued at home and on February 7, 1944, the ulcers were entirely healed. She has since returned to her home in Washington, D. C. and on April 1, 1944, the ulcers were still healed and there was no pain in the leg. Her paralysis has improved until she is able to walk.

CONCLUSIONS

1. Six cases of old chronic ulcers are reported in which the patients were treated with Tyrothricin* with excellent results in five instances and no improvement in one.

2. Tyrothricin did not cause any toxic symptoms in the six patients.

3. Tyrothricin was a good anti-bactericidal agent when applied locally.

4. Tyrothricin caused no pain or discomfort when used locally in the proportion of 0.25 cc. to 99.75 cc. of water.

5. *In five of the six cases* Tyrothricin showed evidences of marked tissue stimulating properties.

6. I am aware of the pitfalls of a small series, but the results were so good, I believe the information should be published so others could benefit from it, while waiting for the accumulation of a large series.

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* The Tyrothricin was furnished through the courtesy of Parke Davis & Co.

SULFONAMIDES IN APPENDICITIS

A REVIEW OF 412 CONSECUTIVE CASES AND AN ANALYSIS OF FATALITIES

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ACUTE appendicitis imposes upon the surgical service direct responsibility for periodic review of cases and their handling in view of its high mortality and the incidence of serious complications. The present review was undertaken for a study of our results following the introduction of sulfonamides administered by the usual routes, including intraperitoneal instillation. The evidence becomes more convincing when placed against the background of previous experiences.

TABLE I

No. of Cases:	
Flower and Fifth Avenue Hospital	163
Metropolitan Hospital	249
Total	412
Fatalities:	
Flower and Fifth Avenue Hospital	0
Metropolitan Hospital	10
Total	10
Gross Mortality:	
Flower and Fifth Avenue Hospital	0%
Metropolitan Hospital	4%
Total	2.4%
No. Receiving Sulfonamides:	
Flower and Fifth Avenue Hospital	34
Metropolitan Hospital	65
Total	99

A study of 103 cases of ruptured appendicitis was completed in 1936 at the Metropolitan Hospital. There were twenty-three deaths in this series, establishing a mortality of 22.3 per cent. It is interesting to note that in this series fifty-four patients were operated upon by the right rectus incision, the mortality rate being 27.6 per cent; while in forty cases with the McBurney incision, the mortality rate was 16.6 per cent. In this series were included ten cases in which appendicocecostomy was performed and the encouraging results obtained in overcoming distention, chemical imbalance, and the control of infection were further studied by McCabe.[1] The gross mortality for all cases of appendicitis admitted to the Flower and Fifth Avenue Hospitals and the Metropolitan Hospital prior to the introduction of sulfonamides was 5.5 per cent.

From June, 1940 to December, 1941, our series comprises 412 consecutive and unselected cases* in which appendectomy was performed. (Table I.) The gross mortality was 2.4 per cent. Irrespective of the cause of death, all fatalities were considered as belonging to the mortality group of appendicitis. Particularly, in the Metropolitan group are found many patients seriously handicapped by organic disease and malnutrition, typical of the class of patients received in public institutions.

Ochsner[2] stated that in the United States one person died from appendicitis every twenty-nine minutes. The United States Census,[3] reporting the most frequent surgical causes of death placed appendicitis (16 per cent) second only to cancer of the stomach (27.2 per cent). Schullinger,[4] reporting 2,653 cases from the Presbyterian Hospital, placed the mortality rate at 5.8 per cent. In large series, the mortality has varied greatly,[5] Thompson reporting not a single death in 204 cases, Horsley 0.95 per cent, Barrow and Ochsner 5.3 per cent, and in the patients with generalized peritonitis the mortality as reported by Horsley was

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* All members of our staff individually and as a group shared in the care of this series of cases, but special credit is due for their aid in the preparation of this report to Dr. John Herrlin, Jr., Dr. Edward J. McCabe, and Dr. Charles Halberstam.

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2.2 per cent, Reid 17.2 per cent, and Barrow and Ochsner 27.3 per cent.

When analyzing the mortality, many factors of importance must be considered. First, among these, is the type of appendicitis. In our studies, we have used the following classification (Table II): (1) Simple acute appendicitis; (2) acute purulent appendicitis with local peritonitis or abscess, and (3) ruptured appendicitis with generalized peritonitis.

Table II

SULFANILAMIDE SERIES

	Flower-Fifth Ave. Hospital	Metropolitan	Total
Group I			
Simple acute appendicitis...	5	2	7
Group II			
Acute purulent appendicitis with local peritonitis or abscess..............	15	38	53
Group III			
Ruptured appendicitis with generalized peritonitis.	14	25	39
Total..................	34	65	99

Another factor which definitely influences the mortality is the time of operation. For instance, Bower[6] established that the mortality rate of cases admitted forty-eight to seventy-two hours after onset is three times that of those admitted within twenty-four hours and jumps to four times the rate after seventy-two hours. A third factor is age with the higher mortality rates in the very young and very old. Additional points to be considered are type of incision, whether appendectomy with or without drainage or drainage alone is performed, type of anesthesia, and associated complications of which pulmonary and cardiovascular are extremely important.

Intraperitoneal sulfonamides were first used at our hospitals in June, 1940. Our first experience was confined to the intraperitoneal introduction of 50 to 100 cc. of 5 per cent neoprontosil. Due to the rapidity of absorption and secretion, this method was soon abandoned in favor of intraperitoneal sulfanilamide or sulfathiazole powder, supplemented when necessary by oral administration of the drug or hypodermoclysis of 0.8 per cent sulfanilamide or 0.5 per cent sulfathiazole. The oral or subcutaneous administration by clysis maintains a more constant blood level and is, therefore, more useful than the intravenous route.

Table III

ORAL AND PARENTERAL SULFONAMIDE

Group I	Flower-Fifth Ave. Hospital	Metropolitan
Age..............	1 to 5 yr., 1 20 to 30 yr., 3 50 to 60 yr., 1	10 to 20 yr., 1 20 to 30 yr., 1
	No. cases, 5	No. cases, 2

Total No. of cases..................	7
Deaths..............................	0
Mortality...........................	0

	Flower-Fifth Ave. Hospital	Metropolitan
Duration prior to operation (average)...........	61 hr.	24 hr.
Appendectomy.....	5	2
Appendectomy and drainage........	0	0
Complications		
Wound infection...	2	Bronchopneumonia, 2
Eosinophilia (undetermined etiology)..........	1	
Postoperative days	14	11

The local use of sulfanilamide permits a concentration localized at the site of infection that has been found to be seventy-five to one hundred times higher than the blood concentration with a consequent increase in bacteriostatic effects.[7] The blood level reaches its peak in from six to twelve hours. Sulfathiazole powder is absorbed more slowly. As a general rule, we have employed about 12 Gm. of sulfanilamide or sulfathiazole, occasionally larger amounts, approximately three-quarters of the total amount in the peritoneal cavity, the balance sprinkled in the wound. The largest single dose we have employed in appendicitis was 18 Gm.; although, we did use 24 Gm. intraperitoneally in a patient with a rupture of the colon secondary to malignancy. Both of these patients recovered without complications that in anyway might be attributable to the sulfonamides. In children, we employ one-half or less of the adult dose. Direct local application provides immediate control of infection and limits spread by local bacteriostatic or even bactericidal action of the sulfonamide. It makes possible a rapid high blood concentration of the compound, thus increasing the constitutional coefficient. We believe that local use often requires supplemental oral or parenteral administration.

Table IV

ORAL AND PARENTERAL SULFONAMIDE

Group II	Flower-Fifth Ave. Hospital	Metropolitan
Age	10 to 20 yr., 4 20 to 30 yr., 1 40 to 50 yr., 1	10 to 20 yr., 8 20 to 30 yr., 6 30 to 40 yr., 4 40 to 50 yr., 4 60 to 70 yr., 1
	No. cases, 6	No. cases, 23

Total No. of cases	29
Deaths	1
Mortality	3.4%

	Flower-Fifth Ave. Hospital	Metropolitan
Duration prior to operation (average)	29 hr.	46 hr.
Appendectomy	5	23
Appendectomy and drainage	1	0
Complications		
Wound infection	1	Wound infection, 8 Pelvic abscess, 1
Pneumonia	1	Ileus, 4 Cecal fistula, 1 Pneumonia, 2 P.O. atelectasis, 2 Pulmonary embolus, 1 Cystitis, 1
Postoperative days	10	18

Table V

ORAL AND PARENTERAL SULFONAMIDE

Group III	Flower-Fifth Ave. Hospital	Metropolitan
Age	5 to 10 yr., 1 10 to 20 yr., 3 40 to 50 yr., 1	5 to 10 yr., 1 10 to 20 yr., 1 20 to 30 yr., 3 30 to 40 yr., 1 40 to 50 yr., 3 50 to 60 yr., 3
	No. cases, 5	No. cases, 12

Total No. of cases	17
Deaths	4
Mortality	23.5%

	Flower-Fifth Ave. Hospital	Metropolitan
Duration prior to operation	29 hr.	45 hr.
Appendectomy	2	6, 1 death
Appendectomy and drainage	3	6, 3 deaths
Complications		
Wound infections	2	Wound infections, 5
Pelvic abscess	2	Ileus, 3 Cecal fistula, 1 Pneumonia, 2 P.O. atelectasis, 1 Delirium, 1 Leucopenia and possible subhepatic abscess, 1
Postoperative days	20	15

Sulfonamides were given by the oral route alone to a total of seven patients belonging to Group I, the simple acute appendicitis. (Table III.) As might be expected, there were no deaths. In Group II, acute purulent appendicitis with local peritonitis or abscess, sulfonamides were given to a total of twenty-nine patients by oral and parenteral routes. (Table iv.) The single death occurred on the fifth postoperative day, in a twenty-nine-year old female (S. W., Record No. 719) with extreme obesity and necropsy demonstrated pulmonary embolism, atelectasis and postoperative ileus. Appendectomy without drainage had been performed. In Group iii, ruptured appendicitis with generalized peritonitis, sulfonamides were given to seventeen patients both orally and parenterally and, of these, four died, a mortality of 23.3 per cent. (Table v.)

CASE REPORTS

Case i. F. M., (No. 668), a forty-four-year old male, was admitted July 18, 1940, and expired July 28th. The patient was under treatment for a duodenal ulcer and was admitted to the medical service of the hospital for exacerbation of these symptoms. Thirty-six hours after admission, he was seen in surgical consultation at which time a diagnosis was made of a perforated duodenal ulcer. Roentgenograms were not taken for the presence of pneumoperitoneum, neither was diagnostic peritoneal aspiration undertaken. At operation, through a right rectus incision, no evidence of peptic ulcer was found. The appendix was found ruptured with the presence of diffuse peritonitis. Appendectomy without drainage was done. Colon bacillus was recovered on culture. Postoperatively, the patient was given sulfanilamide by the oral route. Intestinal intubation with the Miller-Abbott tube was successful, completely controlling distention and ileus. The patient also received whole blood transfusions. Wound infection was followed shortly by disruption and was treated by packing and strapping. Bronchopneumonia and epididymitis also developed. The patient succumbed on the ninth postoperative day. Postmortem examination revealed toxic myocarditis, bronchopneumonia, infarction of the right lung, toxic hepatitis, toxic hyperplastic spleenitis, peritonitis, and mesenteric abscess.

Case ii. V. B., (No. 715), a forty-year old male, was admitted May 17, 1934, and expired August 17, 1940. This patient was under treatment for tuberculosis. On August 11, 1940, the patient complained of abdominal symptoms which were attributed to a tuberculous ileocolitis. He was seen in surgical consultation on August 16th at which time a diagnosis of ruptured appendicitis and generalized peritonitis was made. Operation confirmed the diagnosis and appendectomy with drainage was performed. Following the operation, the patient was treated with neoprontosil intravenously and intramuscularly, Wangensteen intestinal decompression, and whole blood transfusion. Extreme sepsis continued with a temperature rise to 107°F. The patient expired twenty-four hours postoperatively, and postmortem examination was refused.

Case iii. M. S., (No. 774), a fifty-nine-year old female was admitted September 4, 1940, and expired September 13th. Operation was performed through a right rectus incision, and a ruptured appendicitis with generalized peritonitis found. Appendectomy with drainage was done. Bacillus coli was cultured from the peritoneal cavity. During the postoperative period, the patient was given neoprontosil intravenously and sulfanilamide orally. Wangensteen decompression of the intestine was instituted and the patient given whole blood transfusions. Cardiac decompensation and auricular fibrillation was present. Peritonitis and ileus continued, and the patient developed a pneumonia of the left lower lobe. Wound disruption further complicated the course and was treated by packing and adhesive strapping. Death occurred on the ninth postoperative day. Autopsy revealed a fulminating peritonitis with ileus and pneumonia.

Case iv. C. O., (No. 874), a fifty-nine-year old male, was admitted October 15, 1940, and expired October 22nd. The history was of seven days' duration and the physical findings those of diffuse peritonitis. At operation, there was ruptured appendicitis with generalized peritonitis with but little attempt at localization. Appendectomy and drainage was performed. Bacillus coli and Staphylococcus aureus were cultured from the peritoneal cavity. Postoperatively, the patient received neoprontosil intravenously as well as sulfanilamide orally. The Miller-Abbott tube was passed and suction instituted by means of the Wangensteen system. In addition, the patient received four whole blood transfusions, totaling 1,500 cc. Postoperative ileus developed. In spite of generous transfusions, secondary anemia and leukopenia developed, which may be attributed to the overwhelming sepsis, although they may have resulted from the sulfonamides. The patient expired on the seventh postoperative day and autopsy was denied.

In Group I, no patient was treated with intraperitoneal sulfonamides. In Group II, acute purulent appendicitis with local peritonitis or abscess, there was a total of twenty-four patients who received sulfonamides intraperitoneally supplemented by oral and parenteral administration when necessary with but one death, a mortality of 4.1 per cent. (Table VI.)

Table VI

INTRAPERITONEAL AND PARENTERAL SULFONAMIDE

Group II	Flower-Fifth Ave. Hospital	Metropolitan
Age	10 to 20 yr., 1	1 to 5 yr., 2
	20 to 30 yr., 3	10 to 20 yr., 3
	40 to 50 yr., 4	20 to 30 yr., 5
	60 to 70 yr., 1	30 to 40 yr., 2
		50 to 60 yr., 2
		60 to 70 yr., 1
	No. cases, 9	No. cases, 15

Total number of cases	24
Deaths	1
Mortality	4.1%

	Flower-Fifth Ave. Hospital	Metropolitan
Duration prior to operation	25 hr.	35 hr.
Appendectomy	0	15
Appendectomy and drainage	0	0
All received intraperitoneal sulfonamide.		
Complications		
Wound infection	1	Wound infection, 2
Pelvic abscess	1	Pneumonia, 1
Pneumonia	1	Cardiac decompensation, 1
		Toxic hepatitis, 1
Postoperative days	14	12

The single death, M. C., (No. 563), a sixty-three-year old female, was admitted June 8, 1941 and expired June 21st. Appendectomy was performed and 50 cc. of 5 per cent neoprontosil instilled intraperitoneally. The abdomen was closed in layers without drainage. During the postoperative phase, the patient received hypodermoclysis of 0.8 per cent sulfanilamide solution, transfusions of whole blood, and supportive therapy for cardiac decompensation and auricular fibrillation. Peripheral circulatory collapse developed which was believed to be secondary to cardiac decompensation and generalized peritonitis. The patient expired on the third postoperative day, and at autopsy toxic myocarditis was found with generalized peritonitis and pericecal abscess.

Table VII

INTRAPERITONEAL SULFONAMIDE

Group III	Flower-Fifth Ave. Hospital	Metropolitan
Age	5 to 10 yr., 2	5 to 10 yr., 3
	10 to 20 yr., 2	10 to 20 yr., 1
	30 to 40 yr., 3	20 to 30 yr., 2
	40 to 50 yr., 1	40 to 50 yr., 2
	50 to 60 yr., 1	50 to 60 yr., 3
		60 to 70 yr., 1
		70 to 80 yr., 1
	No. cases, 9	No. cases, 13

Total No. of cases	22
Deaths	3
Mortality	13.5%

	Flower-Fifth Ave. Hospital	Metropolitan
Duration prior to operation	56 hr.	52 hr.
Appendectomy	7	9, 2 Deaths
Appendectomy and drainage	2	4, 1 death
Complications		
Wound infections	1	Wound infections, 7
Hypoprotenemia	1	Pelvic abscess and ileus, 1
		Intestinal obstruction, 1
		Cecal fistula, 1
		Pneumonia, 1
		Thrombocytopenia purpura and hyperleucocytosis, 1
Postoperative days	14	10

Intraperitoneal sulfonamides, supplemented by oral and parenteral administration when deemed advisable, were given to twenty-two patients in Group III (ruptured appendicitis with generalized peritonitis). In this last group, there were three deaths, a mortality of 13.5 per cent. (Table VII.)

Case I. H. B., (No. 142), a fifty-four-year old male, was admitted January 27, 1941, and expired February 2nd. The patient had active pulmonary tuberculosis with bilateral lesions. There was a 70 per cent collapse of the left lung. Symptoms were present for forty-eight hours prior to admission, and the abdominal signs at time of admission suggested ruptured appendicitis with generalized peritonitis, which was confirmed at operation. Appendectomy without drainage was performed and 50 cc of 5 per cent neoprontosil instilled into the peritoneal cavity. Postoperatively, the patient was given 5 per cent neoprontosil by the intravenous route and sulfathiazole by mouth. Intestinal intubation with the Miller-Abbott tube and Wangensteen suction controlled distention and ileus. Three transfusions of whole blood were given. A wound infection with disruption and a cecal fistula occurred. The patient expired on the sixth postoperative day. Necropsy confirmed previous findings of active bilateral pulmonary tuberculosis with artificial pneumothorax and collapse of the left lung, generalized peritonitis and a cecal fistula.

Case II. J. M. (No. 374), an eight-year old male child, was admitted on February 26, 1941, and expired on March 31st, the thirty-second postappendectomy day. Abdominal symptoms were present for seven days prior to admission to the hospital. At operation, ruptured appendicitis with generalized peritonitis were present. Appendectomy and appendicocecostomy were done. Bacillus coli was cultured from the peritoneal cavity. Five per cent neoprontosil, 50 cc. was instilled intraperitoneally. Postoperatively, sulfanilamide was administered orally for nearly three weeks. Eight transfusions of 250 cc. of whole blood was given. The Miller-Abbott tube was passed into the small intestine. Drainage from the Miller-Abbott tube and the appendicocecostomy was good but did not completely relieve the abdominal distention. The child was kept in an oxygen tent. Severe infection developed in the appendicocecostomy wound and a high temperature persisted. It was believed that further intraperitoneal suppuration was present, although no definite diagnosis of subhepatic or pelvis abscess could be made. There was definite evidence pointing to multiple points of partial intestinal obstruction. A laparotomy was performed on March 31st at which time multiple small intraperitoneal abscesses and numerous adhesions were found. The patient expired shortly after the second laparotomy in spite of careful supportive treatment. Autopsy did not reveal additional data.

Case III. F. K., (No. 123850), a thirty-two-year old male, was admitted on August 6, 1941, and discharged on November 18th. Appendectomy was performed and 12 Gm. of sulfanilamide introduced into the peritoneal cavity. The abdomen was closed without drainage. Twelve hours later, the blood level was total 10.4, free 8.8, conjugated 1.6. Hypodermoclyses of 1,000 cc. of 0.8 per cent sulfanilamide solution was given daily for three days. The blood level on August 7th was total 16.15, free 15.0, conjugated 1.15; on August 8th, total 7.25, free 6.6, conjugated 0.65; on August 9th, total 8.8, free 7.7, conjugated 1.1; August 11th, total 3, free 1.7, conjugated 1.3. The clinical picture indicated the need of further sulfonamide therapy, and on August 11th, 100 cc. of 5 per cent sodium sulfathiazole was given intravenously. Cyanosis and relative anuria, 400 to 500 cc. persisted for the first two postoperative days. The Miller-Abbott tube and Wangensteen suction were utilized for the relief of distention and ileus, and in addition the patient was given two whole blood transfusions. Jaundice was first noted on August 31st and rapidly progressed, the Van den Bergh reaction becoming positive direct and the icteric index reaching a high of 100 on August 15th. The total plasma protein 5.22, albumin 2.5, globulin 2.5, fibrinogen 0.22, vitamin C 0.61. The icteric index fell to 25 on August 20th and 12 on September 2nd. The patient was discharged and returned for follow-up on November 17th at which time the icteric index was 14.8 and the Van den Bergh positive delayed.

This patient is the only one under our observation who exhibited a toxic hepatitis with jaundice, although others have observed it rather frequently.[16,19,20,21]

Case iv. M. M., (No. 909), a four-year old female child, was admitted on October 16, 1941, and expired on October 19th. At operation, a ruptured appendicitis and diffuse peritonitis was found. Appendectomy was done, 4 Gm. of sulfathiazole powder placed intraperitoneally and the abdomen closed without drainage. Sulfathiazole, Gm. ½, was given every four hours, beginning twenty-four hours postoperatively and continuing until October 19th. A total of 3½ Gm. was given by the oral route. The sulfathiazole blood level on October 18th was: Total 3.60, free 3.00, conjugated 0.60. The patient was apparently having an uneventful convalescence until October 18th when blood was noted in one bowel movement. The remainder of the day passed without further incidence, and the following morning the child appeared in good condition. At 2:30 p.m., the patient had a chill which was followed very shortly by foaming at the mouth and a very definite convulsion. At examination, temperature was 98.4°f., heart rate 200. The skin was cool. Small, purplish ulcers were present on the buccal mucosa and tongue. A right facial paresis developed, the eyes deviated to the right, and the pupils became dilated and fixed. The abdomen rapidly became distended. Bloody stool and urine were present. The temperature rose to 103°f. At 5:30 p.m., convulsions developed again, involving the left arm and leg. Convulsions continued again until 7 p.m. Respiration of the Cheyne-Stokes type developed, heart sounds became barely audible, and the patient expired at 7:30 p.m.

The laboratory data are of particular interest. Prior to operation on October 16th, the hemoglobin was 90 per cent, the leucocytes 20,000, the polymorphonuclear leucocytes 75, the lymphocytes 25. The urine was light yellow in color, acid reaction, no albumin or sugar was present, acetone was present, there were no abnormal microscopic findings. On October 19th, hemoglobin was 86 per cent, erythrocytes 3,750,000; leucocytes 80,000; thrombocytes 39,000. The leucocyte differential: mature polymorphonuclear 33; band polymorphonuclear 10; metamyelocytes 10, myelocytes 20; myeloblasts 2; lymphocytes 17; monocytes 2; Turk's irritation cells 2; eosinophiles 2, basophiles 2. The smear also showed marked toxic granulations present in the leucocyte series and 6 nucleated erythrocytes for every 100 leucocytes. Necropsy was denied.

However, there is fairly conclusive evidence that the child expired as a result of thrombosytopenic purpura secondary to sulfathiazole therapy. Thrombocytopenic purpura has been reported to follow sulfathiazole[10,11] therapy as well as sulfanilamide,[12,13] sulfapyridine[14] and sulfadiazine.[15] Hyperleucocytosis has not previously been noted to follow sulfathiazole therapy. This is the only fatal complication which we have observed that could be attributed to sulfonamide therapy. The dosage administered in this case does not appear to have been excessive. The largest single dose we have administered in appendicitis was 18 Gm. of sulfathiazole intraperitoneally and no reaction was observed. In a male child of seven years with a ruptured appendicitis and generalized peritonitis 15 Gm. of sulfathiazole powder was placed within the peritoneal cavity. The following day, the blood level was total 2.04, free 1.82, and conjugated 0.22. Oral administration was begun giving ½ Gm. every four hours for twenty-four hours. The blood level at this time was total 23.68, free 21.62, and conjugated 2.06. Administration of the drug was immediately discontinued, and the uneventful postoperative convalescence continued.

As have others, we have observed mild toxic symptoms following sulfonamide therapy which do not require cessation of the drug or rapidly regress when administration of the drug is discontinued.[16] Cyanosis has frequently been noted with sulfanilamide therapy, and nausea and vomiting have not uncommonly followed sulfanilamide and sulfathiazole therapy. (Fever has occasionally returned rapidly to normal when the drug is discontinued.) Skin rash,[17] frequently resembling that of measles, will follow sulfathiazole, and even acute exfoliative dermatitis has been reported.[18] Cyanosis and delirium were present in two patients following the use of sulfanilamide. Both patients had stormy convalescences. Relative anuria and hepatitis with jaundice has been observed.

Mild urinary complications, namely, crystalluria, occasionally hematuria and rarely relative anuria has been observed. Interruption of the drug therapy and forcing fluids has rapidly corrected the difficulty. Many severe urinary complications have been reported to follow sulfapyridine,[22,23] sulfathiazole or sulfadiazine therapy.[24–32]

Table VIII
COMPLICATIONS

	Parenteral Sulfonamides		Combined Sulfonamides	
	F.F.A.H., Per Cent	Metropolitan, Per Cent	F.F.A.H., Per Cent	Metropolitan, Per Cent
Wound........	35.7	35.1	15	32.1
Pulmonary.....	7.1	26.7	5	7.1
Miscellaneous..	21.4	29.7	10	17.8

Sulfonamides, in a relatively small percentage of cases, incite toxic manifestations of the hemopoietic system. Leucopenia has infrequently been observed. The serious reaction, acute agranulocytosis is not unknown,[33,34,35] but, unfortunately, has not complicated our cases. We have observed mild forms of anemia but no severe hemolytic anemia has developed in our series that might be ascribed to the use of sulfonamides. Aplastic anemia has followed the use of sulfathiazole.[36]

There is apparently little danger of the formation of adhesions from the intraperitoneal application of sulfanilamide powder. However, sulfathiazole powder may be a contributing factor according to several observers.[19,37,38] We have not observed this danger following intraperitoneal implantation, but it has been our clinical impression that sulfathiazole powder has occasionally delayed wound healing. Interference with wound healing has not been noted to follow sulfanilamide.

Recently, it has been emphasized that there may exist an acquired sensitivity to the sulfonamides.[39–43] A patient who has received a previous course with sulfanilamide or one of its derivatives may react adversely to extremely small doses. It behooves the clinician to inquire as to previous administration and, particularly, whether any drug reaction occurred.

We have had no cases exhibiting focal necrotic lesions recently described and attributed to sulfathiazole.[44,45]

The oral and parenteral administration of sulfanilamide was rapidly supplanted by the intraperitoneal application for the more advanced forms of appendicitis.[5,7,8,47,48,49,50,51] Prior to the local use for appendicitis sulfanilamide had been used locally in dental surgery[52] and compound fractures.[53] It was also used intraperitoneally for pneumococcal peritonitis, perforating abdominal wounds,[55] and is now used prophylactically following gastric and intestinal resection and anastomoses.[56,57] There is laboratory and clinical evidence accumulating that the oral and parenteral or intraperitoneal administration of sulfathiazole or its soluble sodium salt is effective in treating peritonitis.[58–63] Its rate of absorption from the peritoneal cavity is slower than sulfanilamide and may, therefore, exert its local action over a longer period. In a number of instances, we have combined the use of 8 Gm. of sulfanilamide and 4 Gm. of sulfathiazole, mixing the powder well, and placing it intraperitoneally at the site of appendectomy. This may prove to be very advantageous, particularly since two or more organisms are frequently cultured from the peritoneal cavity and sulfanilamide is relatively ineffective against the staphylococcus. The use of microcrystals of sulfathiazole[64] may overcome the objections of some that it has a tendency to "cake" and form adhesions. There are relatively few observations on the merits of intraperitoneal sulfapyridine.[65]

With the intraperitoneal administration, the incidence of complications was lower than when only oral and parenteral routes were utilized. (Table VIII.) Similarly, the mortality rate was lower when the sulfonamides were employed intraperitoneally.

Another important consideration in the management of Groups II and III is the question of drainage. In sixteen cases in which drainage was employed, there were four deaths, a mortality rate of 25 per cent; but in eighty-three patients not drained, there were five deaths, a mortality rate of 6 per cent. Drainage is indicated when localized abscess is present, but it adds to the hazard when there is generalized peritonitis. Again in favor of intraperitoneal sulfonamides is a shorter number of hospital days.

It is obvious that many factors have contributed an important share to the reduction of our mortality. Among these is the judicious use of intravenous chlorides, plasma or blood to establish an optimum fluid balance during the pre- and postoperative period. Fluid balance should be established before as well as after operation. The routine use of the McBurney incision has contributed to the lowered mortality rate as has been emphasized by many observers. A better understanding of the rôle of oxygen[66] and improved anesthesia technic share in the credit. Lastly, a more widespread understanding on the part of our staff in the fundamental importance of prompt and continuous intestinal decompression by the Wangensteen[67] or Furness[68] suction as well as efficient use of the Miller-Abbott tube are vital factors in the management of acute appendicitis except for the addition of the sulfonamides. Since then, the mortality rate has steadily been reduced so that since this study was completed a further group of over 200 consecutive patients of all types have been operated upon without a death. There is definite evidence of the great value of the local and general use of the sulfonamides in the reduction of the serious complications and of mortality of in the severe forms of acute appendicitis.

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The cause of cervicitis is always bacterial, the organisms concerned being the *gonococcus*, or any one of a number of other bacteria which are normal inhabitants of the genital canal or which are introduced from the outside. In this latter group the various strains of *streptococci* are most important.

GASTRIC LESIONS HIGH ON THE LESSER CURVATURE

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A GASTRIC lesion situated high on the lesser curvature is at times a difficult problem technically. An ulcer in this area makes it impossible to do a subtotal gastrectomy and at the same time remove the ulcer.

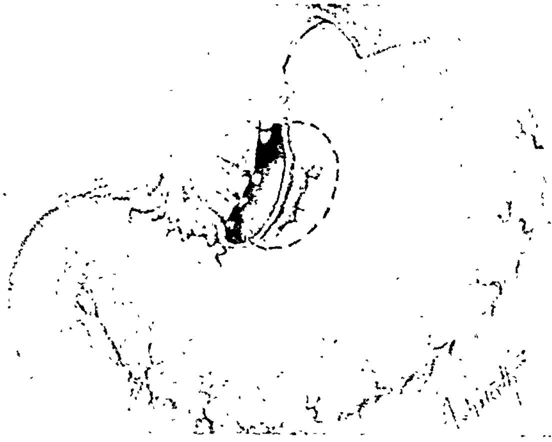

FIG. 1. Elliptical excision of the lesion instead of a v-shaped excision.

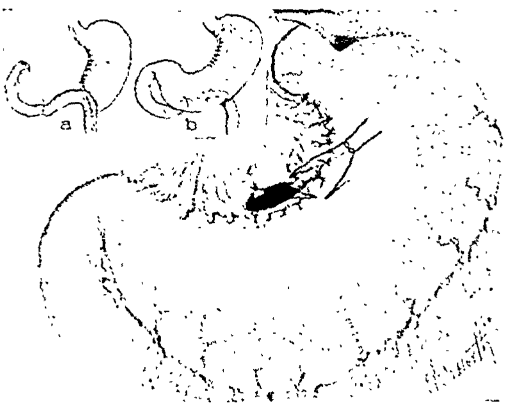

FIG. 3. Completion of suture and choice of (*a*) partial gastrectomy, or (*b*) posterior gastroenterostomy.

The v-shaped resection of such an ulcer, especially if sizeable, leads to considerable buckling and tension of the stomach, and if the ulcer is very high up has a considerable danger of leakage.

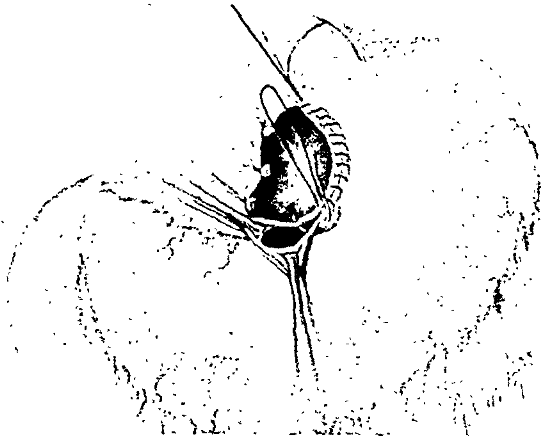

FIG. 2. Suture of anterior wall of the stomach to the posterior wall instead of suturing anterior to anterior and posterior to posterior as in a v-shaped resection.

A gastric carcinoma in this area might well be subjected to a total gastrectomy, yet, in some cases due to difficult exposure, or the condition of the patient, it might be impossible to do this, or too formidable an operation. In other cases if there were a large ulcerative carcinoma of this area with liver metastasis, a total gastrectomy would be contraindicated and yet the removal of the ulcerative lesion might well prolong and make more livable the patient's life. In addition to this there are many reasons why a total gastrectomy is not a desirable operation except for lesions involving the greater part of the stomach or in cases of linitis plastica or in certain types of sarcoma. These reasons are: (1) The mortality is very high in average hands in total gastrectomy, and probably at least 15 per cent even in the most skillful hands. (2) The survival period on the average after total gastrectomy is not long. (3) Stricture at the anastomosis occurs frequently. (4) A total gastrectomy may possibly throw a patient into pernicious anemia who had previously been in a state of balance, but whose *intrinsic factor is dependent more than* usual on gastric mucosa.

I propose and have carried out the following method of handling this type of case: The lesion is removed in an elliptical manner and instead of suturing the defect in the usual manner as after the ordinary v-shape incision of an ulcer, the anterior wall of the stomach is sutured to the posterior wall of the stomach. This may be done even if the lesion extends well down from the cardia. No tension results in this suture and there is no tendency to leakage. A posterior gastro-enterostomy is then done in the usual manner. The reason for doing the gastro-enterostomy is that the innervation and control of the pylorus are interfered with by the resection of the lesion. The possibility of the occurrence *of a jejunal ulcer if this procedure* were to be used for an ulcer with high acidity must be considered. In such a case it might be possible to combine such suture of the gastric wall high up with a subtotal gastrectomy at the ordinary level in place of the posterior gastro-enterostomy, although I have never personally done this as yet. (Figs. 1 to 3.)

SUMMARY

For a limited group of cases of ulcer or carcinoma high up on the lesser curvature of the stomach which for one reason or another may not be considered for total gastrectomy, a method of handling has been suggested and successfully practiced.

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TREATMENT OF FRACTURES

APPLICATION OF THE PRINCIPLE OF REST

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FRACTURES have now achieved outstanding distinction in the general hospital. Three years ago it was estimated by one of our authorities that more than 100,000 fractures occurred annually in the United States. The automobile and high speed travel have brought this about. Statistics indicate that two-thirds of all automobile accidents occur in rural communities; and since the high speed automobile is responsible for the majority of accidents, the hospitals along the main highways receive many of these serious and complicated fractures. As a senior attending surgeon in a not very large but busy and approved hospital on the main highway midway between New York and Albany, the writer has had ample opportunity to treat personally and observe the treatment rendered many fractures. A few observations based on this experience are the inspiration of this paper.

John Hunter advocated rest as a routine measure in the treatment of disabilities of the motor system of the human body. After him came John Hilton who regarded rest as the most powerful aid which the surgeon could bring to the aid of disordered tissues. Hilton elaborated the means of securing rest into a system. Following Hilton, Hugh Owen Thomas made rest his creed and ritual in the treatment of fractures. Thomas believed that an overdose of rest was impossible. To use the expression which was oft repeated by him, rest must be "Enforced, uninterrupted, and prolonged." These three men appeared in British surgery at successive periods; Hunter 1728–1793; Hilton 1807–1878; and Hugh Owen Thomas 1834–1891. With each successive man and period rest became more urgently advocated as the best means of assisting the natural powers of repair to correct the violence done by disease or injury. Hugh Owen Thomas held that in only *one* way could the surgeon aid the repair of injured or diseased tissue and that was by giving the part rest. His message to the surgeons of his time was that they did not understand the meaning of the word rest.

What are the many factors interfering with rest in the management of a fracture? The slogan, "splint them where they lie," immediately applies the principle of rest besides preventing further displacement of fragments. For to transport a patient with a fracture of the shaft of a long bone without adequate splinting results in added vessel, muscle and nerve injury. The limb should be placed as nearly as possible in the position of muscle equilibrium and no patient suffering from a fracture of a long bone shaft should be moved until the best available fixation has been applied. Not infrequently a patient with a fractured femur is placed in the back seat of a car and in this way transported to the hospital. In a fracture of the humerus the weight of the limb, supported at the wrist with a few turns of bandage fixing the arm to the chest, is sufficient to transport the patient in the upright position. Traction in the humerus is frequently unnecessary, in fact overtraction is sometimes obtained from the weight of the forearm itself.

The unreduced fracture is another cause of unrest. Effusion of blood into the tissues and increase of tissue fluid in the region of the injury are normal reactions that make for swelling. Furthermore an irritation of the afferent nerves at the site of the fracture sets up a reflex spasm of the muscles which is nature's attempt to obtain rest. It is much easier to reduce a fracture before the swelling and muscle spasm have occurred. Hence the principle holds that a fracture should be reduced as early as possible after the injury to secure rest. Fractures should, therefore, be treated as an emergency day or night. The terse saying of Strohmeyer regarding strangulated hernia applies equally well to fractures, "Do not let the sun rise on a fracture if first seen at night; and do not let the sun set upon a fracture if first seen by day."

Function and not the *x*-ray should be the basis for judging a fracture result. Many times we are influenced too much by the *x*-ray in the treatment of fractures. Judging the fracture solely on the *x*-ray film alone has often led to many useless manipulations and open reductions. On the other hand failure of *x*-ray to show a cabinet makers reposition of the fragments may result in suits for mal-practice despite the fact that the patient may have a perfect function. This results in frequent attempts to obtain good *x*-ray reduction with unnecessary trauma to nerves, muscles and blood supply and not infrequently non-union. In a fresh fracture the most important single factor in securing union is absolute immobilization, and it is generally conceded that one of the most frequent causes of non-union is incomplete immobilization or repeated changes in the position of the fragments while union is in progress. When immobilization is not practicable from the beginning and traction is necessary, immobilization preferably with plaster should be applied as soon as traction is no longer needed.

Other factors interfering with rest are faulty fixation and pressure. If circular casts are applied they should be bi-valved immediately since pain and pressure are forms of restlessness. Anything which surrounds or compresses a joint or bone assists in the repair in so far as it lessens the movement of the joint, but hinders it in so far as it compresses it, since it impedes the circulation of the limb.

Another form of unrest is too early and too vigorous application of physical therapy. There is at this time a wave of physiotherapy sweeping the country and in many instances this has done more harm than good because it is begun too early and too vigorously. While it is true that the muscles and joints should be exercised whenever and wherever possible, yet this should not interfere with rest. The principle of rest should be applied the moment the fracture is seen and continued until the fragments are firmly united by callus. Since union is the first consideration in the treatment of fractures, an effort to secure union in good functional position should dominate the treatment. Our efforts to obtain movement in the neighboring joints and power in the muscles of the limb should be of secondary consideration, for the first objective in the treatment of any fracture is to secure union, and only rest gives the fragments every possible chance to unite. There are many ways of treating the same fracture, each method having its advantages and disadvantages. A close statistical study of any series of fracture cases, however, will reveal that delayed union and non-union occur less often when the principle of rest "absolute, uninterrupted and enforced" can be employed from the very beginning.

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Case Reports

ISOLATED FRACTURES OF THE FIRST RIB ASSOCIATED WITH BLAST FORCES

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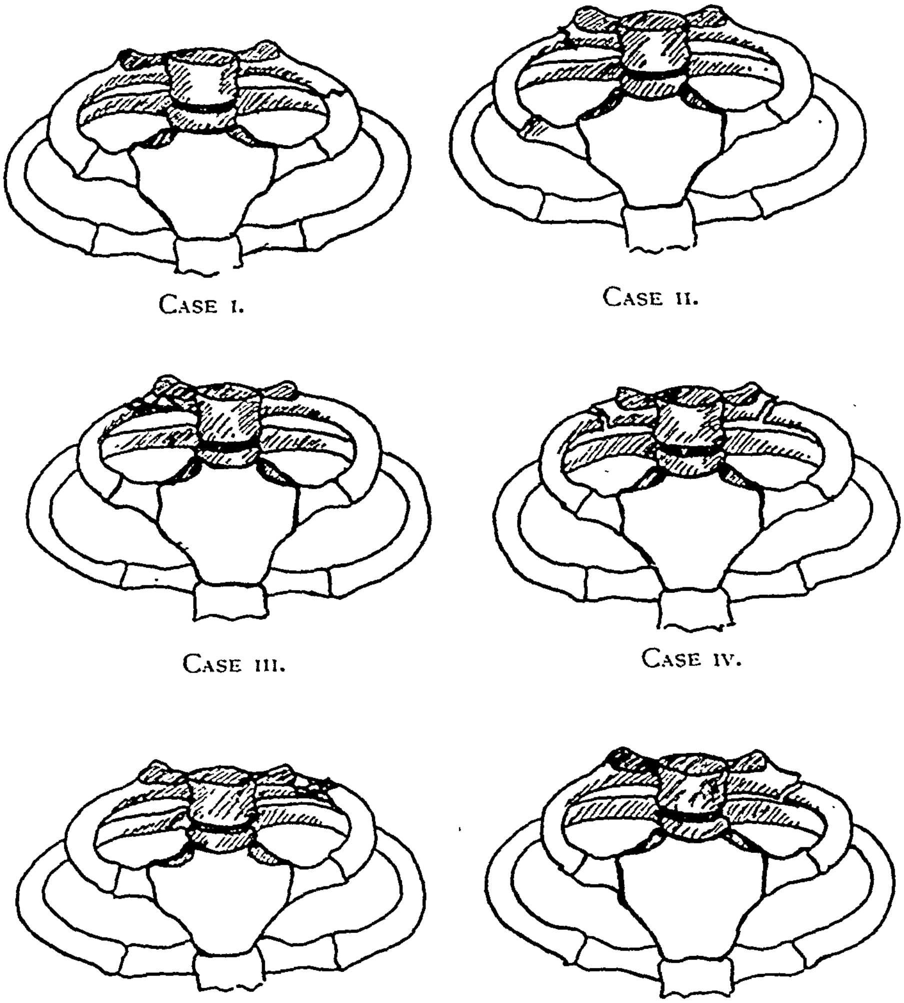
BECAUSE of the rarity of isolated fractures of the first rib report is herein submitted of seven such fractures incurred by six sailors in an explosion at sea. These cases are also of interest because of the presumed mechanism of injury. In none does the history suggest direct injury to the rib, but all were exposed to blast force. Review of the literature on blast injuries does not reveal mention of fractures of the first rib. Hence, the value of keeping in mind the possibility of this fracture in such injuries might well be emphasized in this report. Conversely, when this fracture is found it would be appropiate to seek other possible injuries that may also have been caused by such induced force, for, as will later be described, fractures of the first rib alone are not very likely to be caused by direct injury. The two logical mechanisms are indirect pressure and muscle tension.

CASE REPORTS

CASE I. While standing in line in the galley passageway near the officers' quarters, this sailor saw a flash from these quarters. He felt himself lifted from the floor and lost consciousness. Upon revival he saw sparks and flames around him, and found that he was lying on several other men. A hot metal bar was bent across but not touching him. While sliding out from under this, he burned his hands. He has no further recollection until revival at this hospital. Injuries consisted of fracture of the left first rib at its midpoint, second degree burns involving 41 per cent of skin surface with smaller sites of third degree burns, bilaterally perforated ear drums and blast injuries of both lungs. This sailor was admitted on January 3, 1944, and was discharged on January 25, 1944, to another hospital. He was ambulatory on discharge.

CASE II. While standing in line in the galley passageway this sailor heard an explosion, saw a flash of light, and was rendered unconscious. When he revived there was much smoke about him and he was unable to stand. He crawled to the deck through the officers' mess and was carried by stretcher to the Coast Guard boat. Injuries involved fracture of the right first rib at the tubercle, bilaterally perforated ear drums, deep second degree burns, including 52 per cent of skin surface, with multiple third degree sites over the lower extremities, and laceration on the right side of the face. This man was admitted January 3, 1944, and was discharged greatly improved, to another hospital on February 1, 1944, by ambulance.

CASE III. This sailor steered the ship into the harbor, anchored, and went to sleep about three and a half hours before the explosion. He awoke in this hospital. Injuries consisted of comminuted fracture of the right first rib posterior to the tubercle, deep second degree burns, involving 48 per cent of skin surface, with many third degree areas over the lower extremities, bilateral blast injuries of the lungs, blast injury of mediastinum (hemorrhage?), traumatic perforation of the right ear drum, and temporary psychosis. This man was admitted on January 3, 1944, and discharged greatly improved to another hospital on January 25, 1944, by ambulance. At this time he felt well, his lungs had cleared and he was apparently mentally normal.



Case i. Case ii.

Case iii. Case iv.

Case v. Case vi.

Fig. 1. Chart of fractures.

Case iv. While standing in line near the galley passageway, this sailor saw a flash and was lifted from the floor. He reached the outside deck without aid although he remembers no details. He was then told that his left thigh was bleeding severely. Shortly thereafter he lost consciousness and was revived only after admission to this hospital. Injuries involved bilateral fractures of the first ribs, anterior to the tubercles, deep second degree burns, involving 82 per cent of the body surface with numerous third degree areas, large (12 inch by 2 inch) laceration-avulsion of the left thigh, and traumatic perforation of the left ear drum. This sailor was admitted on January 3, 1944, and was discharged greatly improved on February 1, 1944, by ambulance.

Case v. While waiting in line in the galley passageway, this sailor heard an explosion and felt stunned. He recovered consciousness on the floor and saw numerous glowing lights. His mind was clear but he was unable to move for a short time, and felt numb. When able to move he went aft to the open deck. There he missed a step and sat heavily on the deck, following which he was evacuated to the Coast Guard boat. His injuries included comminuted fracture of the left first rib posterior to the tubercle, deep second degree burns, involving 65 per cent of skin surface, with numerous third degree areas, bilateral traumatic perforations of the ear drums and several foreign bodies in the right eye. He was admitted on January 3, 1944, and was discharged by ambulance to another hospital in a greatly improved condition and able to walk on January 25, 1944.

Case vi. This sailor, while waiting in line in galley, heard an explosion and was forced against a wall by it. He felt repeated electric shocks and was thrown to the floor, unconscious. Upon reviving he was unable to move, but was assisted to the deck and evacuated to a Coast Guard boat. Examination revealed fracture of the left first rib just anterior to the tubercle, deep second degree burns, involving 50 per cent of the body surface, with numerous areas of third degree burns, traumatic perforation of the right ear drum, and laceration of forehead. He was discharged on January 25, 1944, to another hospital, ambulatory.

All of the above cases were critically ill on admission to the hospital. Strenuous therapy for their burns was primary. Chest *x*-rays were indicated immediately in Cases I and III because of severe hemoptysis, and later in Case IV when mild transitory hemoptysis was observed and in Cases II, V and VI because of chest pains.

INCIDENCE

Judging from the infrequency with which cases of isolated fractures of the first rib appear in the literature, this injury is a rarity. However, this impression must be tempered with the understanding that, unless complications occur, the course is very benign, localizing symptoms very obscure and mild, and the causative injury or force frequently diffuse. Hence, cases may be easily missed. In 1935, Oldfield described a case of bilateral first rib fracture, and referred to ten cases of unilateral fractures reported by Friedl. One of these ten cases was bilateral. In 1937, Breslin found twenty-seven cases in the literature and added five of his own. In 1938, Outland and Hanlon reported one case. Another case was reported by Aitken and Lincoln in 1939. In 1943, Cohen reported three cases found during routine chest *x*-ray studies in 3,000 selectees.

ANATOMY

To understand the mechanics, symptoms and complications of this fracture, knowledge of the local anatomy is essential. The first rib is the shortest and the most fully curved. It has the shortest costal cartilage. Its position differs markedly from that of the other ribs in that, instead of having inner and outer surfaces and upper and lower borders, it has upper and lower surfaces and inner and outer borders. These factors all contribute to the rigidity of its position and lack of resiliency as compared with that of the other ribs.

The curve of the rib is compounded at the *tubercle by a secondary downward* curve toward its vertebral attachment. This portion of the rib is also markedly thinned. At the junction of the vertebral two-thirds with the sternal third of the rib, on its upper surface, is the tubercle for insertion of the scalenus anticus muscle. In front of this tubercle is a groove for passage of the subclavian vein, and behind it a similar groove for passage of the subclavian artery. Behind this groove for the artery is the site of insertion of the scalenus medius muscle. At this site the first interdigitation of the serratus anterior muscle takes origin from the outer margin of the rib. Other muscles that are attached to the rib, but are of little importance are the subclavius, which takes origin from the anterior end of its upper surface, and the intercostals. The brachial plexus emerges between the scalenus anticus and medius and crosses the first rib, separated from it only by the lowest fibers of the scalenus medius muscle and the subclavian artery. The inner border of the rib is in contact with the parietal pleura overlying the upper lobe of the lung. Anteriorly, the costal cartilage of the first rib is attached to the upper lateral angle of the manubrium and to the clavicle.

The first rib is protected anteriorly and above by the clavicle, anterolaterally by the coracoid process, so forming a relatively deep recess for it, which is covered by the pectoralis major muscle. Lateral protection is afforded by the neck and acromion process of the scapula and by the humerus. Posteriorly, the scapula shields the rib without covering it. However, in this region it is covered by thick layers of muscle. These include the trapezius, levator scapulae and rhomboid minor, splenius capitis and cervicis, and the erector spinae.

The possibility of pressure applied to the clavicle where it crosses the first rib forcing it back against the rib and so fracturing the latter without fracturing the clavicle may be eliminated with realization that a distance of at least one-half inch separates the two bones, and this space is cushioned by the subclavius muscle and costocoracoid membrane. This latter relatively firm structure tends to stabilize the local bony relationships by its tense bracing position between the first rib, clavicle and coracoid process.

This rib is most subject to fracture at and posterior to the tubercle where it becomes thinner and descends to its vertebral attachment. The vascular grooves also are relatively weak sites.

MECHANISM OF FRACTURE

Reference to the pertinent anatomy, as described in the preceding section, makes obvious the conclusion that fracture of the first rib by direct force is practically impossible without very severe injury to the overlying structures. However, indirect force from diffuse pressure to the chest transmitted to the first rib through the sternum may well cause its injury. This is the mechanism that is believed to have caused the fractures herein reported. The blast force applied against the chest causes fractures where the thoracic wall resiliency is least, that is at the first rib.

Several cases reported in the literature suggest muscle action to be the etiologic factor. This may be understood by visualizing the points of rib fixation at the vertebral and sternal ends and where the subclavian artery and vein cross it. Sites of upward forces are at the insertions of the scalenus anticus and medius muscles. With such muscle pull suddenly and strongly applied, fracture may well occur at the anatomic weak points, at and posterior to the tubercle where the rib is thin and at the sites of vascular crossings.

SYMPTOMS

Symptoms of the fractures were very few in this series. In fact, the condition was not diagnosed or even suspected before roentgenography. The *x*-rays had been ordered because of frank hemoptysis in two cases (blast injuries to the lungs), bloody sputum in a third, and severe diffuse chest pains in the other three. In none was pain reconciled to the position of the first rib.

COMPLICATIONS

Reference to the anatomy indicates how brachial plexus or major vascular injuries may be incurred. In the literature several cases of abscess formation have been cited. Possibility of injury to the underlying lung and pleura exists as with any other rib fracture. One of our patients developed a bloody sputum on his fourth day of hospitalization. He complained of no pain, although at that time he was swathed in bandages, and because of the discomfort of multiple injuries, may not have recognized the local discomfort due to the lung injury if such existed. Because of this hemoptysis, an *x*-ray of the chest was ordered, and bilateral fractures of the first ribs found. However, we cannot say definitely that the fractured ribs caused the hemoptysis which ceased within twenty-four hours.

TREATMENT AND PROGNOSIS

No specific treatment for this condition is required. The patient should avoid all physical activity that may cause sudden, forceful movements of the neck for a period of one month. Complications are handled as they arise. The prognosis is excellent; untoward sequelae are more likely to be due to complications than to the basic fracture.

CONCLUSION

Six cases with seven isolated fractures of the first rib have been reported. The mechanism of these is attributed to the indirect force transmitted to the first rib from the blast pressure against the thoracic cage. In each case the diagnosis was made after x-ray examination for other thoracic complications revealed this fracture to be present. No complications were had and no specific treatment given.

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Cervical polyps are small pedunculated tumors which arise usually from the intracervical mucosa, but which may at times spring from the external or vaginal surface of the cervix. They are single or multiple, usually of bright red color, and of rather fragile, spongy structure.

SPONTANEOUS RUPTURE OF THE SPLEEN

TWO CASE REPORTS

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THE literature is replete with case reports of traumatic and spontaneous rupture of the spleen, particularly in the last two decades. Several of these reports have related spontaneous rupture of the normal organ in which no history of trauma could be elicited. A case reported by McCoy even occurred during sleep. The mechanism of rupture is somewhat a point of conjecture insomuch as two principal types of disorder are found: (1) The convex surface of the spleen which is the usual site of rupture presents a subcapsular hematoma which may itself rupture with consequent hemorrhage into the peritoneal cavity; (2) the tear occurs in one of the fissures or through the parenchymal substance of the spleen without subcapsular hemorrhage.

Many case reports of spontaneous rupture have been related in diseased spleens. The conditions mainly responsible are typhoid fever, malaria, mononucleosis, tumors, cysts, torsion of the pedicle, and others. "Spontaneous" rupture infers that there has been no history of trauma or that the degree of trauma has been so insignificant that it may not be considered a causative factor. Of interest is a group of forty-six cases reviewed by McIndoe in 1932 presenting delayed hemorrhage following minor physical effort or injury. In any of the pathological entities reported, the degree of splenomegaly and the bogginess of the splenic pulp would seem to predispose the organ to spontaneous rupture.

The following cases are examples of diseased spleens in which spontaneous rupture occurred. In both, there is no real history of trauma. Signs of intraperitoneal hemorrhage were recognized promptly, and both were subjected to successful laparotomy. King, in 1941, reported the only other case of ruptured spleen in infectious mononucleosis that could be found in the literature. Although neither of these cases presented accessory spleens, one should always be mindful of Curtis and White's observation that accessory spleens occur in 10 per cent of all autopsies, and that rupture of an accessory organ is not uncommon.

CASE REPORTS

CASE 1.* E. B., a twenty-eight year old white male, was admitted to the hospital October 11, 1943. He stated that he felt tired and listless since October 1st and that since October 8th he had suffered with epigastric discomfort and fever. The past history was irrelevant except that he had measles, mumps, chicken pox and pertussis in childhood. He suffered episodes of non-specific prostatitis in 1942 and 1943.

Examination revealed a well developed male, being 71 inches tall and weighing 165 pounds. There was a slight icterus of the sclerae and mucous membranes, and there was mild redness of the pharynx. Widespread lymphadenopathy was present, particularly in the axillary and cervical regions, and there was a very prominent submental node. There was mild tenderness in the epigastrium and the spleen was barely palpable.

A diagnosis of acute mononucleosis was made and confirmed by the finding of 17,450 white blood cells of which 72 per cent were lymphocytes and 20 per cent monocytes. The heterophile antibody test was positive in a dilution of 1:1280 on October 12th. Icterus index at this time was 12. The cholesterol flocculation test was 4+ and prothrombin time was 95 per cent of average normal.

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* This case is being presented in detail elsewhere by Ochs, Banks and Benenson.

His progress was uneventful until October 18th when suddenly, at 11 A.M. without any known injury, he went into shock. There was severe epigastric pain referred to the left shoulder, cold clammy skin, a blood pressure of 80/60, and pulse of 100. A diagnosis of ruptured spleen was made and the patient given 2,000 cc. of plasma until blood could be collected for transfusion. He was taken to the operating room at 3 P.M., and under bilateral novocain intercostal block and supplemental pentothal sodium, a high right rectus incision was made. The peritoneal cavity was filled with fluid and clotted blood, 1,000 cc. of which was recovered for autotransfusion. The spleen was found to be enlarged about three times normal size and was extremely boggy and friable. There was a large subcapsular hematoma over the convex surface which had ruptured. Splenectomy was easily performed. A transfusion of an additional 2,950 cc. of blood was administered. Convalescence thereafter was uneventful and the patient was discharged from the hospital on the twenty-third postoperative day. The mononucleosis was cured by the fifth postoperative day with the following hematologic findings: red cells, 2,940,000; white cells, 14,000; hemoglobin, 65 per cent; 85 per cent polymorphonuclears, 6 per cent lymphocytes, and 7 per cent eosinophiles.

The pathological report (gross) was as follows: The specimen consists of a spleen which is definitely enlarged measuring approximately 19 by 11 by 2.5 cm. It is characterized by a huge rent extending from the upper pole into the midzone in a ragged serrated contour. This tear penetrates the substance of the spleen for a distance of 2 cm. The capsule is thin and the consistency of the organ is almost semi-fluid. Manipulation of the spleen results in penetration without any pressure on the capsule. (Microscopic): Section shows almost total absence of trabeculae. These are reduced to strand-like structures of their composing cells. The persisting trabeculae show active mobilization of the cell components into histiocytes, monocytes, and plasma cells. There are great numbers of these named cell elements crowding the sinusoidal spaces. Myelocytes are seen rather infrequently. The capsule of the spleen seems to have undergone a cellular dissipation to such an extent that the capsule is composed of a single cell layer. Vascularity does not appear to be increased and the number of red blood cells seen in the sinusoidal spaces is not abnormal. Pathological Diagnosis: Reticulo-endothelial hyperplasia of the spleen with mobilization of fixed tissue elements.

CASE II. W. A. Y., a white male, age twenty-nine, was admitted to the hospital December 18, 1942, with a complaint of sudden acute epigastric pain spreading over the entire abdomen. This was followed by nausea and vomiting and two watery bowel movements. During the sixteen hours between the onset of symptoms and the time of admission to the hospital pain became progressively more severe. There was no history of previous gastrointestinal disturbance.

Examination revealed a well nourished and well developed male weighing 162 pounds. His respiration was greatly increased due to apparent abdominal pain. The blood pressure was 120/84. The abdomen presented generalized board-like rigidity which was more pronounced over the upper half.

His preoperative laboratory work consisted of a blood count and urinalysis. There were 3,790,000 red blood cells, 26,150 white blood cells, 92 per cent polymorphonuclear cells, and a hemoglobin of 76 per cent. On the basis of the white count, the examining surgeon made a presumptive diagnosis of acute appendicitis.

He was taken to the operating room and a McBurney incision revealed free blood in the peritoneal cavity and a normal appendix. The McBurney incision was closed and a high right rectus incision substituted. Exploration revealed splenic rupture and removal of the organ was easily accomplished. He was given a transfusion of 1,000 cc. of whole blood while on the operating table which supported his dropping blood pressure. Convalescence was complicated by a hypostatic pneumonia but the patient recovered satisfactorily and was discharged on the twenty-fifth postoperative day.

The pathological report (gross) was as follows: The specimen consists of a moderately enlarged spleen weighing approximately 200 Gm. The inferior and lateral aspects are greatly roughened by blood clots and hemorrhage. Elsewhere the capsular surface is slate gray, smooth, and glistening. Upon section the reddish-brown, moderately-firm pulp contains a number of dark purplish-red hemorrhagic nodules. Some of these approach and project slightly from the capsular surfaces and the roughened area mentioned above. These apparently represent the source of the abdominal bleeding. The nodules vary in size from a few millimeters up to 1 to 2 cm. and vary from circular to ovoid in shape. (Microscopic): There are nodular masses of thrombotic and hemorrhagic extravasation into relatively normal splenic pulp. The immediate surrounding pulp does not show evidence of compression as would be expected from expanding hemorrhage. Small tongue-like processes of pulp tissue may be seen partially subdividing some of the hemorragic areas. Some of these areas encroach upon and perforate the capsule. Pathological Diagnosis: Multiple hemangiomas of the spleen with perforation of the capsule.

SUMMARY

Two cases of spontaneous rupture of the spleen are reported: one in a case of infectious mononucleosis with splenomegaly, the other in a spleen with multiple hemangiomas. King, in 1941, presented the only other case of splenic rupture in mononucleosis reported in the literature. Both of the cases presented herein recovered following splenectomy.

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EXTENSIVE PILONIDAL CYST*

CASE REPORT

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RECENTLY a large number of papers have appeared concerning the treatment of pilonidal sinus and cyst.[1,3-4,5,6,7,8,11,12,13,14,16,17] The methods of treatment vary, although most authors discuss different means of obliterating the dead space after excision, others present radical departures from the usual therapy.[2,9] At this hospital, the premise is followed that each case is a problem within itself and so the procedure for each patient is individualized as the characteristics of the lesion indicate. The case reported here was a patient with a large pilonidal cyst with extensive ramifications of the secondary tracts requiring radical excision to obtain a satisfactory result.

CASE REPORT

The patient was a thirty-eight year old white man who entered the hospital because of pain and discharge about the anus. One year before, the patient had an anal abscess which required incision and drainage by his physician. Healing took place after about three months and the patient had no further difficulty until two months before his admission here. At this time he had noted severe aching pain about the anus. For two weeks before admission there had been a discharge of purulent material without decrease in pain. The family and past histories were non-contributory.

The general physical examination showed no abnormalities. To the left of the anus was a triangular scar in which there were three small openings, with another opening just posterior to the scar. Moderate redness, swelling and tenderness were present about the anterior limb of the scar. In the midline posteriorly was a fifth opening, and to the right of the anus was a sixth opening. Pressure on the swollen area produced a purulent discharge from the openings posteriorly and on the right. A slit-like opening, in which hair could be seen, was present just below the tip of the coccyx and ten more openings were scattered over the sacrococcygeal area. By limited gentle probing, the tracts were all found to communicate with one another.

Clinical laboratory finding showed a red blood cell count of 3,940,000, hemoglobin 70 per cent (Talquist), white blood cell count 8,850 with 76 per cent polymorphonuclear forms. The urinalysis was negative; Kahn test was negative. Culture of the purulent discharge showed Bacillus aerobacter aerogenes.

The patient was given sitz baths twice daily and mineral oil each evening. The inflammatory reaction rapidly subsided and the discharge decreased. Operation was done under spinal anesthesia on the seventh hospital day. A careful search was made for an internal (or primary) anorectal opening but none could be found. The fistulous tracts about the anus, including a cystic area posteriorly, were first excised. The end of the strand of hair was found protruding into this posterior cyst. The cyst and tracts over the sacrococcygeal region were then excised, which necessitated dissection down to the sacrococcygeal fascia. The plan had been to leave a bridge of intact skin in the region of the coccyx by tunneling subcutaneously, but this was found impracticable because of the superficial tract in this area. The connecting tract containing the strand of hair was therefore excised completely. Because of the anticipated difficulty in healing, an attempt was made to reconstruct a bridge of skin and subcutaneous tissue at the level of the coccyx. Two sutures of silkworm gut were placed through the skin and through the fascia over the coccyx. The skin for a distance of about 3 cm. was approximated with interrupted fine silk. The remaining open areas lying above and below the coccyx were loosely packed with gauze moistened with azochloramid.

Pathologic study showed foci of inflammatory cell infiltration, especially of round cells, throughout. There were a number of tracts traversing the subcutaneous tissue, which were lined with squamous epithelium and contained hairs. Some of these showed inflammatory reaction. There was also a larger tract lined by granulation tissue with many polymorphonuclear and giant cells in addition to the round cells.

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* From the Surgical Service of the Station Hospital, Fort Myer, Virginia, Colonel M. F. DuFrenne, Commanding.

The wound was dressed every other day and the packs replaced. At the end of ten days, the bridge of tissue over the coccyx was firmly healed with union to the coccygeal fascia. There was very little discharge and healthy granulation tissue was present in the open areas. Following this, an ointment containing 6 per cent sulfanilamide and 10 per cent cod liver oil in lanolin was applied daily. Progress thereafter was very rapid. Twenty-eight days after operation, the upper half of the wound was almost healed and the lower half was two-thirds healed. Eleven days later healing was complete and the patient was discharged from the hospital. He has remained well to date.

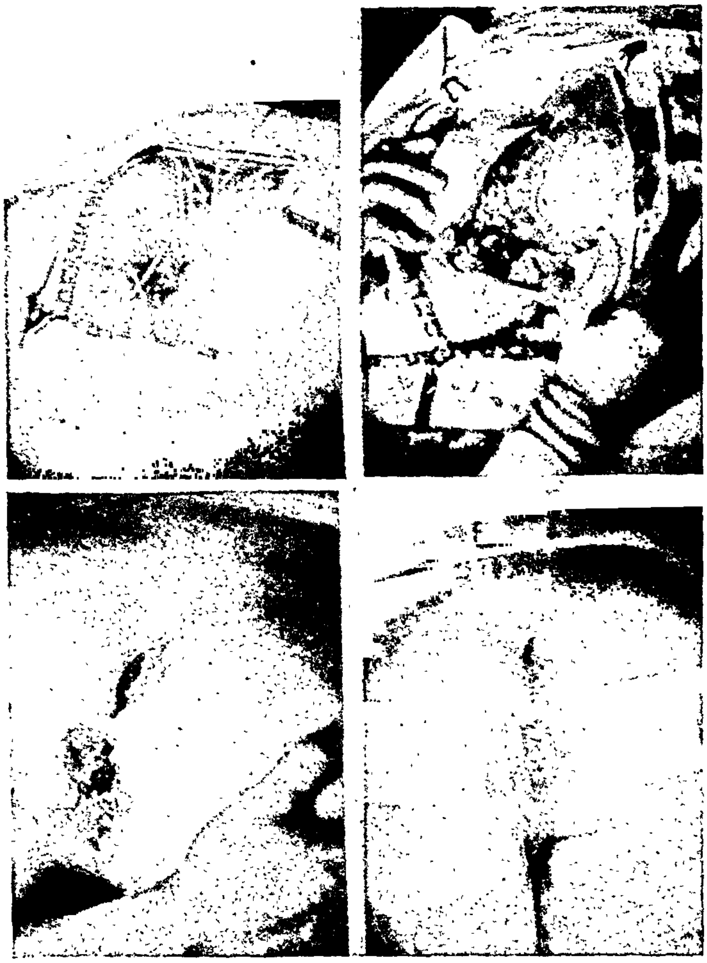

Fig. 1. Upper left: Extent of lesion prior to operation, with applicators in larger openings; upper right: extent of wound after excision; lower left: healing fourteen days after operation; lower right: twenty-eight days after operation, healing nearly complete.

COMMENT

The recent excellent summary by Kooistra[10] makes any review of the literature unnecessary here. Several features of the reported case were interesting. The extent of the lesion was unusual. When the patient was first seen, a diagnosis of fistulo-in-ano and pilonidal cyst was made. This combination has been reported by Warman.[15] As no internal opening could be found at operation, it was apparent that the extension was entirely from the pilonidal cyst. The advantage of leaving a bridge of intact tissue in the region of the coccyx when the tract extends in this direction has been noted by others in the treating of fistulo-in-ano, and a two-stage operation may be preferable to opening this entire area because of difficulty in healing. Fortunately, firm union resulted in the sutured tissue of this case, and this was an important factor in hastening final healing. The preparation of sulfanilamide and cod liver oil in lanolin was modified from the formula suggested by Brezin.[3] This also aided greatly in the healing process as evidenced by the small amount of discharge and the rapid growth of firm healthy granulation tissue.

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A FOREIGN BODY BETWEEN THE RECTUM AND BLADDER

CASE REPORT

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FOREIGN bodies are frequently found in the intestinal tract and their presence is explained in one of five ways: (1) They were swallowed; (2) they were introduced through the anus; (3) they were formed within the intestine; (4) they entered by some pathologic process from another organ, and (5) they got into the intestinal tract as a result of a violent injury.

There are many reports in the literature of foreign bodies swallowed intentionally, for the most part by insane persons, or accidentally, usually with the knowledge, but often without the knowledge, of the patient. When the object is swallowed without the patient's being aware of so doing, the symptoms of which he complains are varied; and these patients present great difficulty in diagnosing the source of their trouble. Symptoms vary with the nature of the object swallowed and with the portion of the intestine in which the object is arrested. Many of the objects, even though sharp, pass through the alimentary tract without causing any symptoms, while others cause slight pain, intense pain, serious injury to the gut, resultant peritonitis and death. Swallowed objects are most often arrested in the esophagus, pyloric orifice, duodenum, ileocecal valve, somewhere in the flexures of the large bowel, and last and most frequently in the anus.

In a cursory search of the literature six interesting cases of a sharp object in the intestinal canal were noted. There are many more in the literature and a still greater number which were never reported, but these six reports are of special interest.

Smith[1] published a report of a darning needle found in the appendix by Mr. Christopher Martin which was shown before the Midland Medical Society, November 12, 1919. Although the patient had no explanation for the presence of the needle, the symptoms of which she complained during the preceding twenty years indicated the course of the needle through the alimentary canal. In 1897, she suffered from indigestion and a diagnosis of gastritis was made. In 1907, the patient had a violent attack of hematemesis, vomiting about two pints of blood and she nearly died. Subsequently, she suffered from occasional recurrences of epigastric pain. In July, 1913, about a month before the needle was found, she had an attack of pain in the region of the duodenum. A medical man whom she consulted thought the pain might be due to appendicitis. She has had no recurrence of symptoms since the removal of the needle.

Akers[2] reports the case of a man who had a pin in the rectum for thirty years. Symptoms of pain of a pricking character in the rectal region on sitting down, constant desire to defecate, great pain on defecation with the stools small, pipe-like and streaked with blood, had been present for more than thirty years. The pin was found just within the anus above the sphincter muscles. After the pin was removed all symptoms subsided. The patient was unable to account for the presence of the pin.

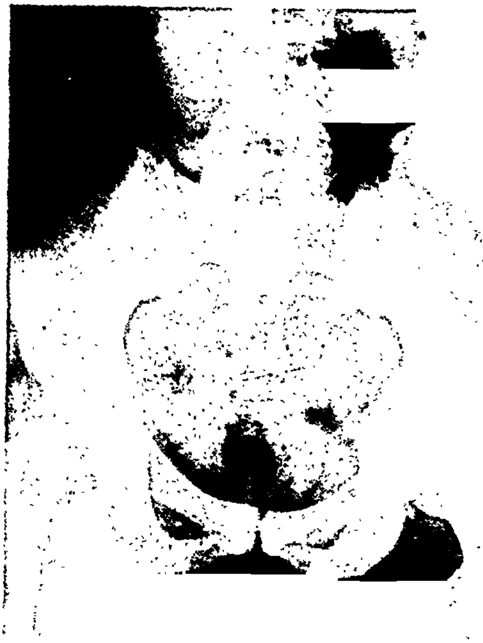

Fig. 1. X-ray before proctoscopy showing the pin at the level of the lowest sacral vertebra.

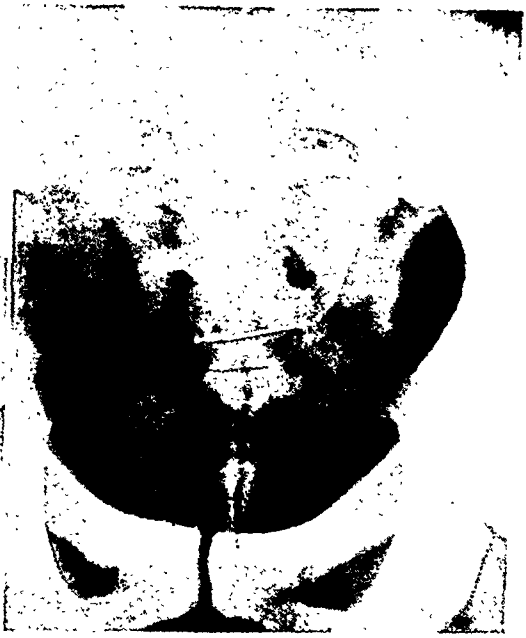

Fig. 2. X-ray taken after proctoscopy showing pin in a more transverse position at the level of the lowest sacral vertebra. The pin is slightly bent.

Carp[3] in a review of forty-eight proved cases of foreign body in the intestine, cites the case of a child who swallowed a pin, which caused death from peritonitis. He found that a sharp object took from two days to three weeks to go through the intestinal tract, and says that in order of frequency the rectum, cecum and sigmoid offer the best anatomical sites for the arrest of foreign bodies. He concludes that a foreign body may travel from the intestine into another organ, or into the peritoneal cavity and from there into muscle planes with little or no symptoms.

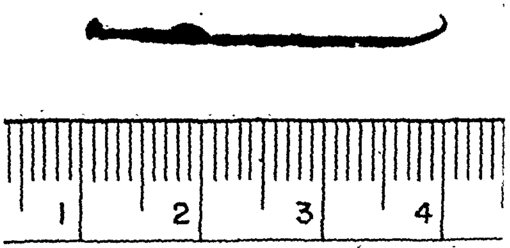

Fig. 3. The ordinary pin is about 2½ cm. while this pin is slightly over 3 cm. in length.

David[4] reports a case of a fish-bone which was swallowed and was passed through the urethra.

Cordier[5] reports the case of a boy, sixteen years old, who for two or three years complained of symptoms pointing to the bladder. He had pain in the right inguinal region and great tenderness extending to the median line, which at first was diagnosed as typhoid fever. On passage of a sound into the bladder a stone was felt. At operation two stones were found, one about the size of a pigeon's egg and a second suspended from the fundus by a short veil-pin protruding into the bladder. A fecal concretion was attached to the head of the pin.

Mueller,[6] in a report before the Philadelphia Academy of Surgery, tells of a thirty-four year old female who swallowed a pin which was removed nine years later. She complained of pain in the loin and in the right iliac fossa, together with frequency of urination. An x-ray revealed a stone in the lower pole of the right kidney and a pin at the level of the sacro-iliac joint, lying in the course of the ureter. Removal of the kidney stone and the pin allayed all symptoms.

CASE REPORT

The case we are presenting was a male, A. H., aged twenty-six years, admitted to the Norwegian Hospital on November 20, 1942, with a diagnosis of foreign body in the rectovesical space. The chief complaint was pain in the low back of a week's duration. The pain was increased on sitting or walking. The past history and family history were irrelevant.

On November 13th, while working in a shipyard, the patient felt pain in the lower back radiating to the coccyx. *X*-ray revealed a foreign body of the shape and size of a long pin, lying in the middle of the lower pelvis. (Fig. 1.)

Physical examination revealed the blood pressure to be 120/80. The general appearance was that of a young, adult male, well developed and apparently in good health. The pupils reacted to light and accommodation. The tonsils were normal. The heart, lungs and abdomen revealed nothing abnormal. The genitourinary system showed nothing of note.

On November 20, 1942, a proctoscopic examination by one of us (C. G.) revealed three ulcers, varying in size from ¼ to ¾ cm. just below the level of the rectosigmoid, which bled slightly on touching with an applicator. There were some feces in the rectum which were removed by enema. A sharp object which was between the bladder and rectum was felt with the end of the proctoscope, anterior to and outside the rectum. Because of the uncertainty of the exact position of the object with reference to the peritoneal reflection, it was thought best not to attempt its removal through the rectum. After finishing the proctoscopic examination another *x*-ray revealed the object still present, anterior to the rectum, with its position slightly changed. (Fig. 2.)

Cystoscopic examination by one of us (F. O.) failed to reveal the pin in the bladder.

On November 23rd, an exploratory laparotomy was performed. The bladder was distended with fluid through a catheter, which was permitted to remain *in situ*. A midline incision was made extending from below the umbilicus to just above the symphisis. The rectae muscles were separated, the peritoneum opened and the pelvic structures inspected. To the left of the midline, on the posterolateral surface of the urinary bladder, a dimpled area with injected edges was noted running in a transverse direction. Palpation of this area revealed the presence of the pin. An elliptical incision was made in the peritoneum, enclosing the pin, and the pin with the surrounding tissue was excised. The bladder was then repaired with No. 00 chromic, purse-string suture, and the peritoneum closed with No. 00 plain gut. The abdomen was closed with black silk. (Fig. 3.)

The patient was discharged from the hospital on December 4, 1942, symptom free. He has since been inducted into the armed forces.

SUMMARY

1. Several interesting cases of the presence of a sharp object in the intestinal tract are noted.

2. A case is reported of a young, adult male, in whom the *x*-ray showed the unexplained presence of a long pin, lying between the bladder and rectum.

3. The authors are unable to explain the symptoms of which the patient complained by the presence of the pin in the position in which it was found.

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OBTURATOR HERNIA*

REPORT OF A SUCCESSFUL OPERATION IN AN EIGHTY-THREE YEAR OLD WOMAN

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OBTURATOR hernia was first observed by Arnaud De Ronsil in 1724 when he reported one case before the French Academy of Science in Paris. Later in 1768 a case was reported by his son G. Arnaud De Ronsil and this was the first instance in which a strangulated obturator hernia was reduced successfully by taxis.

Laparotomy for strangulated obturator hernia was first performed by Hilton in 1848. Dr. Leigh R. Watson collected from the literature 420 cases up to 1938 and reviewed the histories of 396 of these cases. He found it occurred with equal frequency on the right and left sides; in twenty-one cases it was bilateral. The diagnosis was rarely made before operation or necropsy and the Howship-Romberg sign was noted in sixty-eight cases. The mortality was very high, 151 out of 228 cases.

Obturator hernia, as the name suggests, is a hernia that descends through the obturator foramen or canal and the sac may occupy several positions although it commonly follows the course of the vessels. The sac is formed by peritoneum and usually contains small intestines. The size of the sac is small because of the resistance offered by the obturator and the pectineus muscles as well as the obturator membrane and the narrow canal. This type of hernia is most common in old, emaciated women, due to the relaxation of peritoneum from pregnancies, the loss of fat, the greater size of the obturator foramen and the shape of the pelvic canal.

The predisposing causes are those conditions that produce abnormal increase in the intra-abdominal pressure as emphysema, asthma, chronic coughs, laborious occupation and lifting heavy objects.

The diagnosis of simple reducible obturator hernia is seldom made. Where strangulation is present the symptoms are those of intestinal obstruction, the most common and important diagnostic finding is the numbness, burning sensation and pain on the inner thigh down to the knee which is produced by pressure on the obturator nerve. This sign was first described by Howship in 1840 and later Romberg in 1845 and is known as the Howship-Romberg sign.

On examination a swelling with tenderness may be present in the obturator region below and internal to the femoral ring. This swelling and tenderness sometimes is best detected by pelvic or rectal examination.

The treatment of obturator hernia is operative and the truss should not be used. Where strangulation is present, an immediate operation is recommended without the use of taxis. The abdominal route is the method of choice although few prefer the obturator route. When the latter route is used, sometimes it is necessary to open the abdomen and treat strangulation or hemorrhage.

In the abdominal route a low right or left rectus incision is made and if strangulation is present the intestines are released by gentle traction and the bowel is treated in the regular way. The sac is inverted by picking the lower end with a hemostat. After placing a ligature at the base it is resected. Sometimes it is easier to place several sutures through the sac and allow it to act as a plug for the obturator orifice.

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* Read before The Philadelphia Academy of Surgery, January 4, 1942.

If the sac cannot be inverted, the peritoneum is loosened and stitched together.

CASE REPORT

C. D., a white woman, aged eighty-three years, was admitted to the surgical service of Dr. P. A. McCarthy at the Philadelphia General Hospital on October 1, 1942, complaining of pain in abdomen with nausea and vomiting. The abdominal pain began September 29, 1942, two days before admission to the hospital. The pain gradually grew worse and she could not hold anything in her stomach. A physician was called in and he advised her to go to the hospital.

On admission, beside the history of the pain, nausea and vomiting she stated that she had no bowel movement and no passage of gas since the onset of the trouble. She had similar attacks before but none so severe as the present one. She also stated she had a lump in the left inguinal region which came out while standing on her feet and disappeared after lying down. She wore a belt which kept the lump down. She had had no chills, fever or cough prior to the onset of her present illness and no definite history of change in bowel habits.

Due to her general weak condition it was impossible to get a satisfactory past history. When she was first seen at the hospital the pulse was 100, temperature 98°F., respiration 20 and blood pressure 180/105. The physical examination of the head and lungs was negative. There was a loud systolic murmur heard all over the precordial region. The abdomen was distended with visible peristalsis which gave a high pitched tinkling sound on auscultation.

There was no rigidity and no tenderness anywhere over the abdomen and there was no palpable abnormal masses. The liver, spleen and kidneys presented no detectable abnormality. A careful examination was directed toward the inguinal, femoral and perineal regions for possible strangulated hernia but none was found.

The left inguinal ring was markedly dilated but there was no palpable masses. The skin in this region was excoriated from the truss which she used. The extremities were negative and so was the pelvic and rectal examinations.

A flat x-ray plate of the abdomen showed a few stepladder shadows and there was an accumulation of gas in the ileum which produced the distention and suggested the possibility of small bowel obstruction. The dilated loops were directed toward the right pelvis which suggested that the disorder might be in that region. The urine was negative and the blood count showed red blood cells 4,210,000, white blood cells 18,950 with 90 per cent polymorphonuclears; hemoglobin was 91 per cent.

The patient was given fluids with 5 per cent glucose intravenously and a Miller-Abbott tube introduced into the stomach. The tube never passed beyond the pyloric orifice although a few hours were spent in the fluoroscopic room trying to guide it into the duodenum. About 11 P.M. that same evening, seven hours after admission, I operated upon the patient under continuous spinal anesthesia. After the patient was anesthetized another thorough examination was made for strangulated hernias but these were not found.

We opened into the peritoneal cavity through a low, right rectus incision. The peritoneum was found to be thin and friable. The small intestines were hyperemic and distended. No pathological condition was noted in the ileocecal fossa. On examining the pelvic cavity a flattened loop of the ileum was observed. This was followed and was found to have passed through the right obturator foramen in the anterolateral region and caused complete obstruction. By gentle traction the small loop of the ileum, about 15 cm. in length, was removed from the foramen and fortunately was still viable. There was a thick fibrous tissue cord which ran from the ascending colon to the femoral ring. This was bisected and had nothing to do with the acute obstruction.

No attempt was made to repair the sac or to close the orifice as the patient was a poor surgical risk and any kind of repair might have caused hemorrhage from some abnormal vessels and delay the operation. The hernia orifice was less than 1 cm. in diameter, as I could not pass the tip of my little finger through it. The abdominal wound was closed by layers with chronic catgut and reinforced by braided silk sutures which included all the layers.

During the operation the patient received 650 cc. of normal saline and 5 per cent glucose. The operating time was forty minutes and it required 75 mg. of novocaine for the spinal anesthesia.

The patient was returned to the ward in good condition with the Miller-Abbott tube in the stomach. She made a splendid recovery and she was discharged November 7, 1942, in good condition.

Since we could not get an adequate history from the patient or her relatives on admission, I asked her before her discharge if she had had any trouble in the right inguinal region. Her answers were typical of the Howship-Romberg sign. For the past two years she had had attacks of pain in the right groin which radiated down the inner thigh to the knee. These attacks came about every one or two months.

The patient was contacted on December 15th and was enjoying good health with no recurrence of symptoms.

* * *

In the great majority of cases the microscopic pattern of hyperplasia is a frankly benign one. In a small proportion, however, markedly proliferative and adenomatous pictures are produced, and these have often been mistaken for cancer.

The brief excerpts in this issue have been taken from "Textbook of Gynecology," 2nd ed., by Emil Novak (The Williams & Wilkins Company).

FAULTY INTESTINAL ROTATION

CASE REPORTS

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TWO cases involving faulty, third-stage rotation of the intestinal tract have stimulated a review of this subject. It is one which should be of importance to every physician from pediatrician to pathologist.

CASE REPORTS

CASE I. On October 1, 1928, a thirteen year old youth (554 y-28) was brought to St. Mary's Hospital in Rochester, Minnesota, in a motor car. The boy was moribund and died on the litter while in transit to a room. A history of the case revealed that three months previously, while riding in an automobile, the patient had a severe abdominal pain which was relieved by vomiting. Forty-eight hours before being brought to the hospital, the boy again complained of severe abdominal pain which grew progressively worse. Postmortem examination was essentially negative, except for the intestinal tract, which showed a common mesentery for the entire embryologic midgut and volvulus of the gut in the clockwise direction. (Fig. 1.) There was distention and discoloration of the entire midgut from the second part of the duodenum to about the middle of the transverse colon. A diagrammatic sketch was made at the time of postmortem examination. It was evident that there had been an obstructive torsion of the superior mesentery vessels. By untwisting the volvulus it was possible to replace the intestines in their normal position. The postmortem diagnosis was volvulus of the embryologic midgut and failure of the third-stage of intestinal rotation.

CASE II. A male infant three weeks of age (E. T., #14199) was admitted to the Children's Hospital in Chattanooga, Tennessee, on September 19, 1940. A normally delivered, breast fed child, he had vomited after feedings since his fourth day. The vomitus was yellow or green and fecal in odor. The first stools had blood and mucous; later there had been marked constipation.

When admitted, the infant had a distended abdomen with hyperactive, visible peristalsis, dehydration, rectal temperature of 100°F. and a white blood count of 8,350. With intermittent stomach suction, intravenous fluids and transfusions, his condition improved. There occurred attacks of vomiting but constipated stools were obtained by enemas. While hospitalized, there were attacks of abdominal distention, with visible peristalsis and vomiting. This, and a normal colon *x*-ray, made a diagnosis of partial intestinal obstruction from embryologic cause.

The abdomen was explored on October 4, 1940, through a right paramedian incision. There was distention of the small intestine. The duodenum was dark red in color and vomitus of old blood occurred after manipulation. Heavy bands of adhesions (Fig. 2) were found, extended from the root of the mesentery to the jejunum at the duodenojejunum fold. The first part of the jejunum was narrowed but patent. The remainder of the small intestine was negative except for a shortened mesentery, until the lower ileum was explored. There extensive fibrous bands existed between the cecum and lower ileum. There was an extensive Jackson's veil. The constricting adhesions were released and a jejunostomy tube inserted. The infant failed to recover from the operative shock and died in twelve hours. The postmortem examination of the abdomen showed no abnormalities other than the operative findings.

Much of the embryology of the intestinal tract was described by Meckel's publication of Wolff's work,[1] as far back as 1812 and more accurate additions were made by Mall[2] in 1898. In an incomplete review of embryological intestinal literature, it is found that the following writers agree in the principal changes which take place in the development of the intestinal tract:

Arey,[3] Bailey,[4] Broman,[5] Dott,[6] Cunningham,[7] Huntington,[8] Jordan,[9] McMurrich,[10] Mall,[2] Frazier and Robbins,[11] Pernkopf,[12] Hertzler,[13] and Prentiss and Arey.[14]

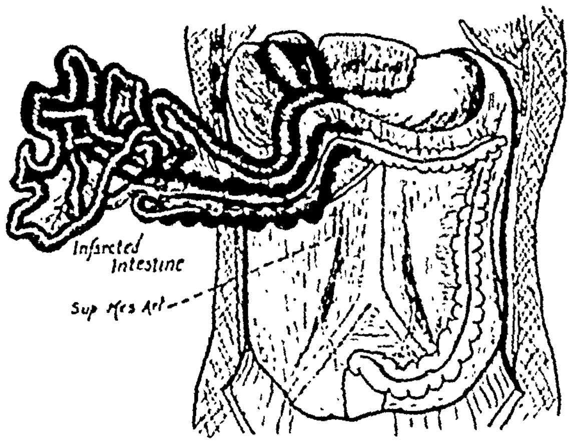

FIG. 1. Volvulus of embryological mid-gut with no peritoneal attachment.

In the state of the primitive streak, an infolding of the entoderm and of the splanchnic layer of mesoderm begins. The edges of the sheets of tissue fuse to form a tube in the longitudinal axis of the embryo. This early intestine is attached throughout its entire length to the posterior wall of the embryo by the future mesentery, and is connected ventrally to the yolk sac by the yolk duct. At this stage of the embryo it is customary to distinguish three parts of the intestinal tract: first, the foregut, which has a ventral as well as a dorsal mesentery; second, the midgut, from which develops the lower part of the duodenum, the remainder of the small intestine and the ascending and transverse colon; and third, the hindgut, from which the remainder of the intestinal tract develops. For this paper, only the midgut is considered.

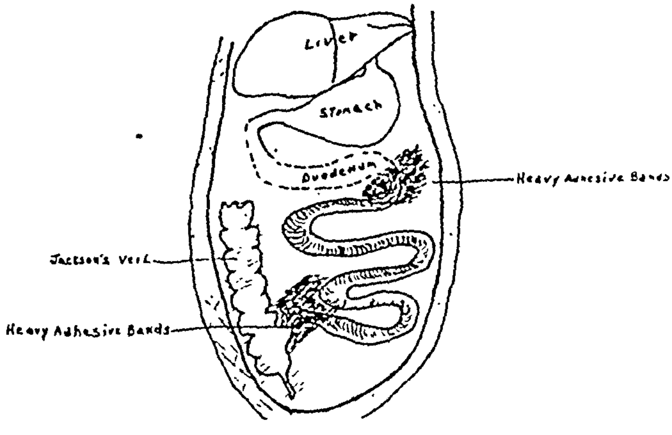

FIG. 2. Diagram of excessive adhesions in third stage of intestinal rotation which caused obstruction.

The midgut increases in length, producing an anterior bend and a lengthened mesentery. The first part of the hindgut grows cephalward and, if not pulled upward, is anchored by a retention band of mesenchymal tissue, described by Frazier and Robbins, by Dott, and by Mall, extending from the root of the superior mesenteric artery to the region of the splenic flexure. The upper part of the hindgut is then nearer the cephalic end of the embryo than the first part of the midgut. Similarly, there is an anchorage of tissue medially from the first part of the duodenum. The midgut is depressed by the umbilical vein which is pulled downward across it by the enlarging liver. A rapid growth of the midgut takes place at this stage of the embryo. Perhaps, due to lack of intra-abdominal space, the midgut is extruded into the yolk sac through the large umbilical opening. This extrusion is referred to as the embryological or physiological umbilical hernia, and is first seen between the 4 mm. and 10 mm. stage of the embryo. The midgut in the umbilical hernia lies outside the abdominal cavity proper and has no contact with other developing viscera. At approximately the 40 mm. stage of the embryo, the intestines return to the abdominal cavity, and after re-entering the abdomen assume the position seen at birth.

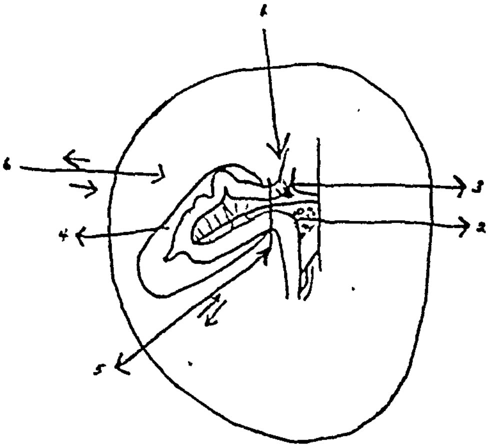

Fig. 3. Diagram of pressures in second stage: 1, liver pressure downward; 2, splenic flexure band; 3, duodenal band; 4, yolk sac with possible adhesions; 5, umbilical orifice; 6, amniotic fluid.

The work of Frazier and Robbins, in 1915, divides the stages of midgut rotation into three parts and is generally followed as a classification. The first is during the formation of the umbilical hernia; the second, is the time during which rotation and return into the abdomen takes place; and the third stage represents the peritoneal fusion and fixation. The embryological age of the different stages of intestinal rotation are: first stage, from the formation of the straight enteric canal to the stage of extrusion into the physiological hernia (4 to 10 mm. embryo). The second stage is during the time of extrusion of the gut into the yolk sac, thereby, forming the physiological hernia, and it ends with the return of the intestines to the abdominal cavity. This return takes place about the tenth week or 40 mm. stage of the embryo. The third stage apparently varies and may exist until after birth. The process then is one of fixation of the intestines by peritoneal absorption and of peritoneal thickening.

It is interesting to consider the forces which may influence the second stage of rotation, that is, the return of the intestine into the abdomen. (Fig. 4.) First, the pressure of the enlarging liver tends to force the upper, pre-arterial loop of intestine downward. A second force is the upward pull and fixation of the hindgut at the future splenic flexure. Third, is the early duodenomesenteric tissue which pulls medially on the first parts of the duodenum. These three have been thoroughly discussed by writers on the subject. But a fourth possible influence is adhesion of the intestine to the yolk sac itself. Adhesion would tend to inhibit the return of the gut or take a part or all of the lining of the yolk sac with it. A fifth mechanism is the size of the umbilical opening in the embryo. At this stage the abdominal wall is closing rapidly and the rate of its closure might alter the intestinal return. A large opening might allow a premature re-entrance and malposition. A small opening may cause a delay and possible adhesions to the yolk sac. Still a sixth factor must be considered in the amniotic fluid which will exert an external pressure on the yolk sac. Should the fluid be excessive there will be an increased force in the direction of the return; whereas a lack of amniotic fluid development would reduce the external pressure on the yolk sac and

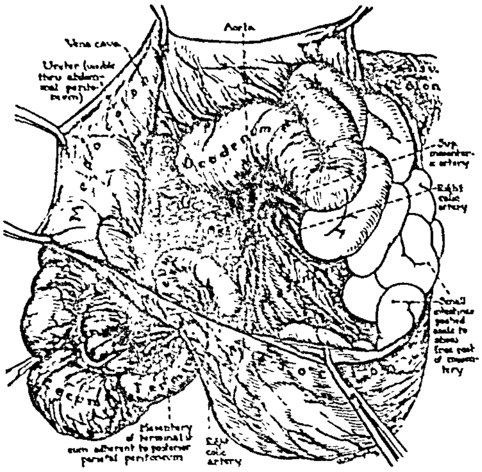
Aorta
Vena cava
Ureter (visible thru abdominal peritoneum)
Colon
Duodenum
Sup. mesenteric artery
Right colic artery
Small intestine pushed aside to show free part of mesentery
Mesentery of terminal ileum adherent to posterior parietal peritoneum
Left colic artery

Fig. 4. Drawing of the contents of the intra-abdominal sac at autopsy showing the relation of the duodenum to the superior mesenteric artery and the terminal ileum to the dextrocolic artery. (From Haymond and Dragstedt.)

the return delayed, allowing time for abdominal wall closure and possibly adhesions of the gut to the yolk sac.

There has been speculation as to the manner and rapidity of the return of the intestine to the cavity. The majority of writers describe the return as rapid and that the small intestine enters first and occupies the abdominal cavity most deeply in first the right and then left regions. The cecum and terminal ileum are the last to return and superficially find their place normally in the right lower quadrant.

A disarrangement or imbalance of any of the described forces may account, not only for the marked anomalies of nonrotation or malrotation, but may be responsible for the extreme variations seen in the shape and position of the intestinal tract of adults. For example, on the rapidity of liver growth depends the degree of depression on the pre-arterial loop of intestine and influences the age at which the future small intestine is pressed downward. The traction band at the splenic flexure, through its size, may not only allow a mobile gut, but by varying tension may distort the transverse colon into the "M" and "U" shapes that are found. The duodenal traction band described by Mall, through its length or absence, may account for the redundancy of the duodenum. The possible accelerating or retarding influence of the umbilical opening size and amniotic fluid pressure might easily distort the normal position of the intestine as they return. A slightly prolonged second stage of rotation might allow some adhesions of the gut to the yolk sac lining and results in a delayed return.

When one considers the balance of forces necessary to produce what is called rotation of the normal intestinal tract, it is not remarkable that we find occasional anomalies and frequent variation, but rather, that we obtain the regularity of design encountered. Yet, by 1934, Gardner and Hart[15] had collected only 105 cases in which these congenital difficulties caused obstruction. They found 52 per cent had occurred in newborn infants with symptoms of obstruction beginning within a few days after birth. The remainder, with various intestinal symptoms, ranged up through the third decade of life.

Surgically, these cases of faulty, embryological intestinal rotation are met with. The simplest forms are the redundant ceci and peculiarly shaped transverse colons. Kantor,[16] in extensive *x*-ray and clinical studies has emphasized the fact that intestinal function is interfered with to varying degrees in the majority of these cases of minor malposition. Embarrassing, surgically, are the left-sided colons and the high, abnormally placed appendices. There may be complete retroperitoneal position of the colon, eleven cases of which have been collected by Truesdale.[17] The most tragic difficulty is that in which there has been a volvulus of the entire midgut, as reported in the first case. And last there is the return of the yolk sac lining with the intestine.

In 1932, Papez[18] expressed the idea that the lining of the yolk sac may return with the intestine, forming the occasionally found third peritoneal sac. His argument, that the anomaly is frequently referred to as the large paraduodenal hernia, is sound. His explanation would cover many of the reported cases such as that reported by Haymond and Dragstedt.[19] *(Fig. 5.)* However, if Papez' explanation is to be accepted, the prevailing opinion of the intestines' rapid return is substantiated, as these large sacs would be forced to return almost *en masse* when the umbilical orifice is widely open.

Regarding the third stage of rotation of the intestinal tract, that is, the fusion of the peritoneal layers, little is known as to its cause. Why the peritoneum, including the mesentery, should fuse in one location and not in another has not been adequately explained. Vague references to plasmaclasts have been made. No one has satisfactorily explained why certain parts of the peritoneum are absorbed and leave behind only the white line along mesenteric and colon margin.

The two cases reported are definite instances of faulty fusion of the midgut to the posterior wall. In the first case, there was no peritoneal absorption, no fixation, and the entire embryological midgut rotated about the vessels and caused death. In the second case, extensive adhesions, rather widely separated, caused obstruction. This is difficult to explain. If the idea of Papez is correct regarding the entrance of the entire lining of the yolk sac to the abdomen to form the occasionally found large paraduodenal hernia or the third peritoneal layer; it is possible that the dense, isolated adhesions encountered in Case II could be the result of adhesions of the intestine in isolated localities and that only a part of the lining of the yolk sac was stripped away and returned with the intestines.

CONCLUSIONS

1. Two cases of abnormality in the third stage of embryological intestinal rotation are presented.
2. The possibility of partial yolk sac adherence could account for the abnormal adhesions in the second case and the question is raised.
3. Forces causing intestinal rotation are considered.

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GAS GANGRENE TREATED WITH SULFATHIAZOLE AND ZINC PEROXIDE

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SULFONAMIDE therapy, both general and local, is useful in the treatment of gas gangrene. It retards the progress of the infection although it does not destroy the anerobic bacilli causing it. These bacilli are best destroyed by nascent oxygen. Zinc peroxide paste inserted into the wound slowly releases its extra molecule of oxygen directly into the area of infection. This free oxygen gradually permeates the gas infection and kills the anerobic organisms. Therefore, sulfonamide therapy combined with the use of zinc peroxide paste makes a very effective method of treating gas gangrene.

The following case demonstrates the successful result of the treatment of gas gangrene with sulfathiazole and zinc peroxide:

CASE REPORT

A white male, R. K. D., No. 17337, age twenty-six, was admitted to Pennock Hospital on October 22, 1941, about 3:00 P.M.

The patient gave the following history: While grinding tomato seeds, he slipped and fell into the tomato grinder causing severe lacerations of the left hand. Due to the damp weather some of the seeds were rotten and moldy with an unusual amount of soil adhering to the seeds.

Routine first aid treatment was given: soap, water, alcohol and merthiolate. The laceration was repaired with subcutaneous plain catgut No. 1 and silk sutures in the skin. He was given 1,500 units of tetanus antitoxin and 1,000 units of mixed gas gangrene antitoxin. Repair was done under a 2 per cent procaine local anesthetic. A sterile dressing was applied and the patient sent home.

At 2:00 P.M. October 23rd, the patient was admitted to Pennock Hospital with the hand badly swollen and painful. He was immediately put on sulfathiazole 0.5 Gm. every four hours. His temperature ranged from 101.6 to 103.4°F. On October 24th, his white blood count was 23,000 with polymorphonuclears 89 per cent. Three sutures were removed and the wound probed with no drainage. On October 25th, the swelling of the hand had definitely increased. The sutures were all removed and the wound entirely opened with no drainage.

The appearance of the hand at this time suggested gas gangrene. The wound was irregated with 1.3000 potassium permanganate and continuous hot magnesium sulfate dressings.

An *x*-ray of the left hand and forearm was ordered which was reported by Pennock Hospital *x*-ray consultant, Dr. W. O. Upson, the following day. *X*-ray examination at this time showed a large amount of gas in the soft tissue of the hand, especially near the metacarpal bones of the ring and little fingers. The appearance was characteristic of gas infection. There apparently was no involvement of the bone or periosteum. On October 26th, the left hand and forearm were *x*-rayed in the morning and showed a definite picture of gas gangrene.

An industrial surgeon was called in consultation and in his opinion it was not definitely gas gangrene. *X*-rays were repeated again that afternoon to note progress. *X*-ray report was that the gas infection was extending some into the fingers, especially the small finger. Consultation advised packing the wound with sulfanilamide powder 4.0 Gm., increasing sulfathiazole to 1.5 Gm. every four hours, blood culture and culture of wound for anerobic bacilli.

On October 27th, the hand showed no improvement. *X*-ray therapy was given of 5 milliamperes 85 peak kilovoltage for five minutes at 20 cm. with a field of 10 cm., dosage 360 roentgens, filter of aluminium of 1 mm. thickness. The anerobic culture with the Wright method, at the end of twelve hours, was positive for gas, and Gram's stain showed Gram-positive encapsulated bacilli. Here was the bacteriologic proof that we were dealing with gas gangrene. The wound was irrigated with hydrogen peroxide and packed with 4.0 Gm. of sulfanilamide powder and moist dressings of potassium permanganate were continued.

On October 28th, the daily x-ray showed the gas infection gradually increasing. Sulfonamide level showed 5 mg. per cc. of blood, so the sulfathiazole 1.5 was continued. In spite of the sulfonamide therapy the infection was progressing. An incision was made on the palmar surface between the small and ring fingers to old wound, with no drainage. The wound was irrigated with hydrogen peroxide. The patient had profuse diaphoresis and his general condition was poor. The wound again was packed with 4.0 Gm. of sulfanilamide powder and the potassium permanganate moist dressings continued.

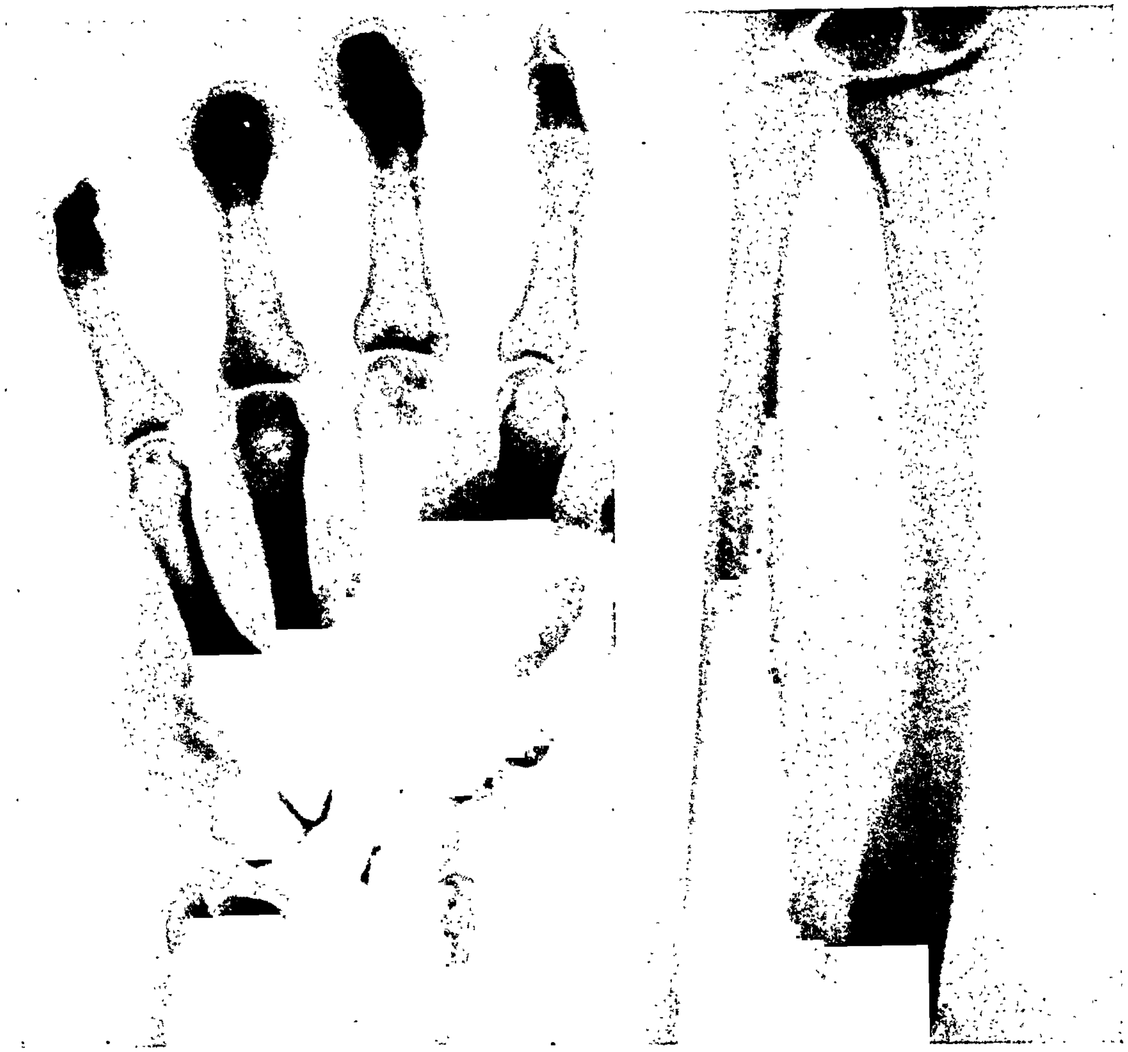

Fig. 1. X-ray of left hand and forearm taken October 28, 1941. This shows extensive gas infection in the soft tissues on both sides of the fourth and fifth metacarpals, around the fourth metacarpophalangeal articulation, and around the proximal and middle phalanges of the small finger.

On October 29th, x-ray showed the gas infection still slowly progressing. The little finger was now completely gangrenous. With the previous sulfonamide therapy the usual rapidity of progress of the gas infection had been greatly impeded but there had been no decrease of the infection.

At this time zinc peroxide powder that had been sterilized for four hours at 140 degrees temperature was made into a paste with sterile water. Small strips of sterile gauze were saturated with this paste and packed deeply into the wound. The moist potassium permanganate dressings were continued; sulfanilamide powder in the wound was discontinued.

On October 30th, x-ray was taken and a definite decrease of the gas was noted. The gauze strips were removed in a hard cast-like form. The wound was irrigated with hydrogen peroxide and again packed with sterile gauze saturated with zinc peroxide paste. On October 31st, November 1st, 2nd and 3rd the dressings were changed and the zinc peroxide paste treatment used each day. Daily x-rays showed a continuous decrease in the gas infection. The general comfort of the patient was markedly improved.

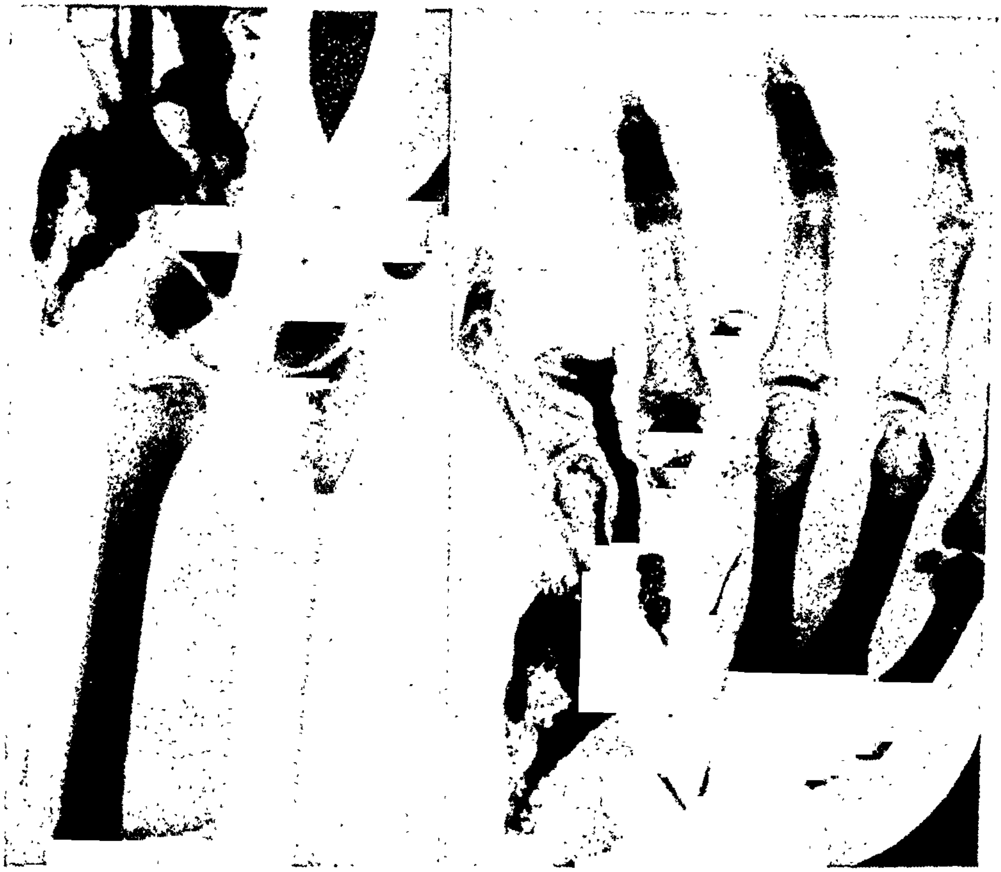

Fig. 2. X-ray taken October 31, 1941, showing two gauze strips saturated with zinc peroxide paste inserted into the soft tissues. Both of these were through, from the dorsum at the proximal ends, to the webs at the distal ends. This x-ray shows forty-eight hours of treatment with this procedure and already very little evidence of gas infection.

The little finger, having become completely gangrenous, was removed when the dressing was done on November 4th. The gangrene was so extensive that no anesthetic was necessary.

On November 5th, the wound was packed again with zinc peroxide paste. X-ray showed no evidence of gas. The pockets showing in the x-ray were air, as the wound at this time was completely open, due to the packing and tissue slough.

On November 6th, the packing of zinc peroxide paste was removed and thereafter the wound was treated as an ordinary infection. The daily irrigations of hydrogen peroxide were continued.

On November 7th, the patient was allowed to sit up in a chair for ten minutes. His condition was improving rapidly and he was removed from isolation. He was soon up in a wheel chair and then walking around. On November 12th, the fifth metacarpal bone was removed. The next day the patient was removed into the ward. On November 15th, the fourth metacarpal was removed and the following day the patient was discharged from the hospital. Drainage was slight, the wound gradually filled in and healed completely.

On February 18, 1942, the patient was admitted to Pennock Hospital. On February 19th, the left ring finger was amputated because of complete lack of function and plastic repair was done on the hand. This surgery was done under general anesthesia. Within a period of a few months this man had complete flexion and extension of the thumb, index and middle fingers of this hand.

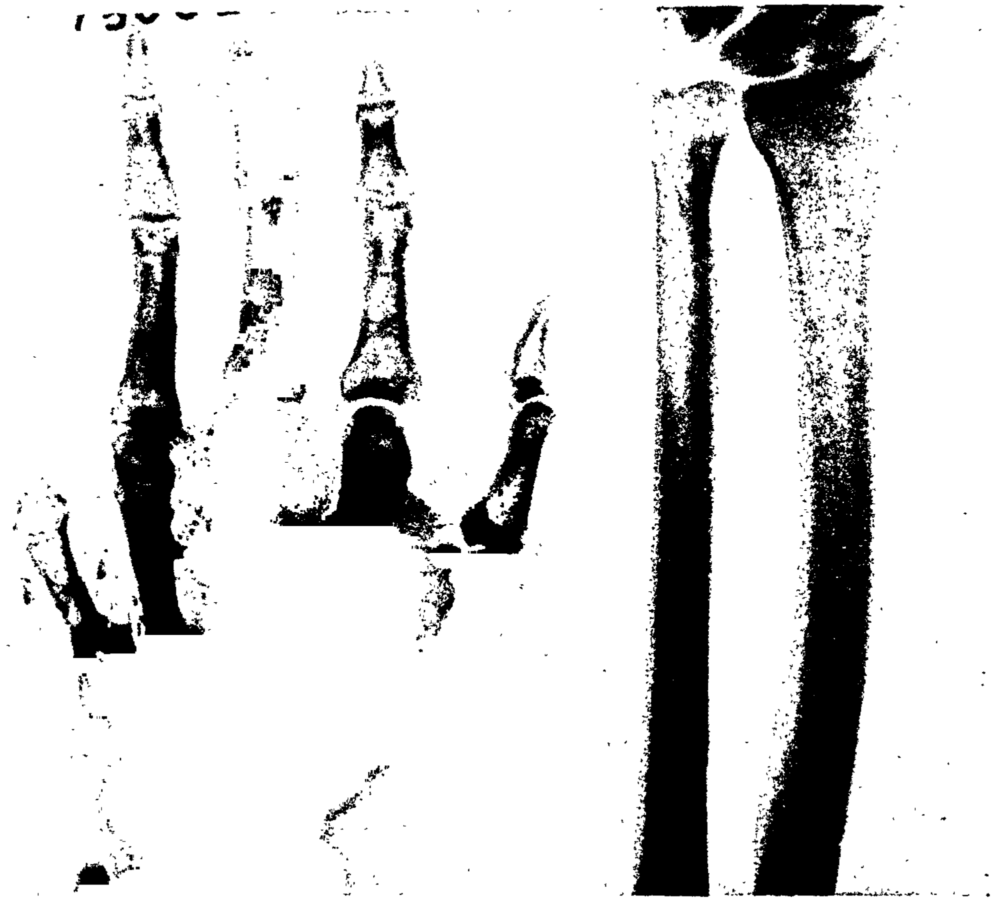

FIG. 3. X-ray taken November 8, 1941, showing left hand after gangrenous small finger had been amputated. Dark areas in the soft tissue around fourth and fifth metacarpals are particles of zinc peroxide paste that remained after gauze strips had been removed. There is no evidence of gas infection in this picture. The distal three-fourths of the fifth metacarpal bone had been freed from its surrounding soft tissue by the gas infection and at this time was almost ready to be removed.

CONCLUSIONS

1. Sulfonamide therapy, both general and local, is helpful in the treatment of gas gangrene.

2. Sulfonamide therapy does inhibit the progress of gas gangrene but does not destroy the anerobic bacilli.

3. Nascent oxygen is the best destroyer of anerobic bacilli.

4. Zinc peroxide made into a paste and inserted deep into the wound on gauze provides an efficient method of releasing nascent oxygen.

5. Zinc peroxide, in the paste form, releases its extra molecule of oxygen slowly allowing it to permeate into the gas infection.

6. Zinc peroxide paste is our most efficient method of getting nascent oxygen where it is needed.

TRAUMATIC CHYLOUS ASCITES*

CASE REPORT

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THE finding of chylous fluid in the peritoneal cavity at operation is a rather striking, as well as a rare phenomenon. There are two main causes of chylous ascites, or chyloperitoneum: first, disease involving the lymphatics, and second, trauma. Trauma may be due to a penetrating wound or a crushing injury. It is significant to note that the crushing injury may be rather minor in character, and ascites develop some time after the injury, two days to four weeks. So far as we are able to determine there have been very few cases of traumatic chylous ascites reported, and no summary of reported cases has been made. We were able to find only five cases reported.

Traumatic chylothorax, on the other hand, although still rare, is more common than chyloperitoneum, and in July, 1938, Shackelford and Fisher collected and analyzed thirty-nine cases in addition to reporting two of their own.[1] In each of their own cases there was an associated chylous ascites but it was mentioned only once in the other thirty-nine cases. Davis[2] reported five cases of chylous ascites in 1939, two of which were apparently due to trauma. He drained his first patient and closed his second; both recovered. Staly, in 1894, and Hall-Moyer, in 1910, each reported a case in which the patient was treated by repeated paracentesis with recovery. It seems, therefore, that traumatic chylous ascites is either very rare, overlooked, or not reported. Certainly the mortality is lower than that of traumatic chylothorax in which the mortality rate averages 41 per cent (Lillie and Fox[3]). Since the loss of chyle is not prolonged, chemical problems do not enter into the treatment. The appearance of milky fluid, unless mixed with blood should make the diagnosis easy. If mixed with blood, it may give the appearance of creamy pus, but when examined microscopically the large fat globules stain readily with Sudan III. There has been much confusion in the literature regarding the classification and differentiation of milky effusions.

Blankenhorn, in 1923, concluded that the term pseudochylous was misleading and should be discarded. Fifteen years later, Harrell, Street and Reiser in analyzing the liquid contents of their own cases and after experimental work on animals, concluded that the term chylous, chyloform, or pseudochylous apply to the same condition, the difference in appearance of the fluid being due to the size of the fat particles and the relative proportion of lymph, chyle and cellular contents.[4]

It was interesting to note that Wyatt and Gross in reporting a case of chylous ascites in an infant believed that the diagnosis of chylous fluid in the abdomen could be made roentgenographically. The radiopacity of chyle, because of its high fat content, is less than other fluids. Therefore, the visualization of solid abdominal organs surrounded by relatively radiolucent fluid suggests the diagnosis of chylous ascites.

As in the thorax, the presence of chyle after trauma means there has been an injury to the thoracic duct or its radicles, so in the peritoneal cavity it means an injury to the cisternachyli (receptaculum chyli) or its contributories.

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* Read before the October 4, 1943, meeting of the Philadelphia Academy of Surgery, Philadelphia, Pa

CASE REPORT

The case being reported is the only one on record at the Abington Memorial Hospital. It is that of a colored man, H. C., age thirty-five, who was admitted to the Pfeiffer Surgical Clinic of the Abington Memorial Hospital on April 4, 1943, complaining of right-sided abdominal pain. He stated that he had been well until the previous day when he developed abdominal pain that seemed to pass from one side of the abdomen to the other across the midline. The pain was aching and crampy in character, and later became right-sided. It hurt him to take a deep breath. The deeper the breath, the worse the pain. He had not vomited and did not have any urinary tract symptoms. He took a laxative the night before admission and had a normal bowel movement in the morning.

At the time of admission there was nothing in his past history that seemed to have any bearing on his present illness. After operation, however, it was learned that he had been in an automobile accident two weeks previously. His car was smashed between a trolley car and a telegraph pole, and he recalled being bumped in the back by the front seat, and pressed against the steering wheel.

Physical examination on admission showed slight distention of the abdomen, mild muscular rigidity, more marked on the right, and tenderness in the right lower quadrant. Peristalsis was active. Otherwise the physical examination was negative with the exception of slight tenderness on rectal palpation that seemed to reproduce abdominal pain. The blood count showed a white blood count of 13,800, but a normal differential. The urine examination was normal. A diagnosis was made by the resident of acute appendicitis, and he was operated upon by Dr. F. M. Simmons Patterson, under spinal anesthesia which was later supplemented by intravenous sodium pentothal.

The operative notes show that a lower right muscle displacement incision was made. On opening the peritoneum, copious amounts of milky fluid exuded. A culture was taken and suction applied. Approximately 600 cc. of fluid was removed, and the entire abdomen explored. The mesentery of the ascending colon was whitish in appearance as was the posterior parietal peritoneum. The stomach and duodenum appeared normal. The mesentery of the entire small bowel showed engorgement of the lymphatic vessels, otherwise the mesentery of the rest of the bowel was normal. The gallbladder was normal in appearance and emptied readily on pressure. The liver, pancreas and spleen appeared normal. There was no enlargement of the mesenteric glands. A diagnosis of chylous ascites was made, but the etiological factor was not determined. Apparently the point of injury was retroperitoneal. The senior surgeons were consulted by the resident, and at Dr. Pfeiffer's suggestion, a routine appendectomy was done with the cautery, the stump inverted, and the abdomen closed in layers without drainage, 5 Gm. of crystalline sulfanilamide being placed in the peritoneal cavity. The patient made an uneventful recovery and was discharged on the eighteenth day after admission. There was no change in the blood chemistry, and the diet was not limited in fats. The urine output was normal in quantity and quality. There was no suggestion of reaccumulation of fluid in the abdomen, and the chest remained clear. An *x*-ray taken showed no evidence of bone injury to the spine.

The patient stated that he felt well until about three months later when he was seized with abdominal pain, crampy in character. He stood it for two days and then came back to the hospital on July 3, 1943, with most of the signs of small bowel obstruction; abdomen distended, projectile vomiting, fecal in character, tinkling peristalsis with rigidity and rebound tenderness. A flat *x*-ray plate in the upright position showed fluid levels in the small bowel low in the pelvis. He appeared dehydrated, although his chemistry and blood count were within normal limits. Intravenous therapy of glucose and saline was instituted at once and a double lumen tube was introduced.

He improved greatly under this treatment. His blood count remained normal and he was always in chemical balance, but he remained obstructed. So on the sixth day after admission a laparotomy was performed under spinal anesthesia. Exploration showed no increase in the peritoneal fluid, and what little there was, was clear. The Miller-Abbott tube could be palpated down to a point in the ileum. From this point on the ileum was dilated. The ileocecal area was enmeshed in adhesions and attached to the parietal peritoneum. Several loops of terminal ileum were bound together by adhesions, and the omentum was likewise adherent to this area. The immediate site of the previous appendectomy appeared to be in good condition. No lesions were demonstrated in the bowel. Lysis of adhesions was performed with scissors, relieving the obstruction. The wound was closed in layers without drainage. The patient again made an uneventful recovery and was discharged on the thirteenth postoperative day. He has remained well to date.

CONCLUSIONS

1. A case of chylous ascites due to trauma is reported.
2. Chylous peritoneum following trauma is rare.
3. It is less serious than chylothorax.
4. Laparotomy with removal of the fluid followed by closure seems to be satisfactory treatment.
5. The cause of the postoperative adhesions in our case may be a subject of the controversy. A culture of the fluid found in the peritoneum at the time of first operation was sterile. We believe that the sulfanilamide probably was responsible for the adhesions found at the second operation.

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